2014

Evaluation of Triploid Oysters as a Tool to Assess Short- and Long-term Seafood Contamination of Oil Spill-impacted Areas

Martin Scott Miles
Louisiana State University and Agricultural and Mechanical College, msmiles@lsu.edu

EVALUATION OF TRIPLOID OYSTERS AS A TOOL TO ASSESS SHORT-AND LONG-TERM SEAFOOD CONTAMINATION OF OIL SPILL-IMPACTED AREAS

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Civil and Environmental Engineering

by
Martin Scott Miles
B.S., Southeastern Louisiana University, 1987
M.S., Louisiana State University, 1994
B.S., Louisiana State University, 2001
December 2014

In memory of my beloved mother: Rosalie Miles

ACKNOWLEDGEMENTS

I would like to thank everyone that has supported and encouraged me during my graduate studies. Thanks to all my committee members for their help with my dissertation research and academic endeavors. To Dr. Donald D. Adrian, for his support and encouragement during these many years. To Dr. Vince Wilson for all those constant friendly reminders to complete my research. To Dr. John Supan, for providing the triploid oysters and allowing me to conduct my field work at his Grand Isle facility. Without his assistance, this research and dissertation would not have been possible. To Dr. Edward Overton, for his encouragement, support, and guidance during my years of research. He has been a mentor and a friend. Dr. Ronald Malone, thank you for this opportunity you have given me and the words of wisdom you shared during our long lunches. I would have never been able to complete my research without your drive and encouragement.

I would like to especially thank Ms. Buffy Meyer and Dr. Heng Gao for helping with my research and taking up the slack when I was busy in the field or laboratory. I would like to thank Dr. Jerome La Peyre for his friendship, advice, and allowing me to use his oyster laboratory for my exposure experiments at LSU. Special thanks to all the student workers that helped with sample collection and preparation throughout my research.

To my long-time friends for their moral support and encouragement over the years. To all the members of my family: my father, E.D. Miles, and brother, Eddie Miles, for their love and encouragement since I was a small child.

Last, but not least, I would like to thank my wife and children for their endless encouragement and love while working on my dissertation. For not complaining about all those long days and nights I was working in the laboratory. Lisa, thank you for all the love and happiness you have given me over the years. I could not have done this without you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Many of the organic components of oil have the capacity to persist in the environment, bioaccumulate in tissues, and are toxic to surrounding organisms. Since the early 1970s, environmental assessment programs have utilized bivalves as monitoring tools of chemical contaminants in the marine environment. Because of their sedentary and filter-feeding habit (bioaccumulation), mussels and oysters been employed as sentinel organisms in environmental quality monitoring studies in coastal ecosystems. The use of indigenous (diploid) bivalves for biomonitoring water quality is limited during the summer months due to high stress and changes in biochemical composition induced by reproductive development.

In this work caged diploid and triploid oysters were compared to one another to determine if seasonal variations in total polycyclic aromatic hydrocarbon (PAH) bioaccumulation exist between the ploidy. Variations in bioaccumulation between the two ploidy were tested using a static laboratory exposure study and a real-time field monitoring (15 months) study in Barataria Bay, Louisiana. A modified QuEChERS and dispersive solid phase extraction (dSPE) method were developed and validated for determination of PAHs in oyster tissue.

Laboratory oil exposure results showed there was a significant increase of 40.0%, 45.3%, and 48.9% in total PAH content between the summer diploid and triploid oysters with the 500, 5000, and 25000 ppm exposure treatments, respectively. There was a 31.3% to 58.2% increase in total PAH content between the summer diploid oysters and remaining seasonal treatments (winter diploid and triploid) over the

exposed oil treatment range (500, 5000, and 25000 ppm). Significant increases (17.2% to 33.4%) in total PAH content within the triploid oysters were observed at the Bay Jimmy field sites for the months coinciding with the spawning season (June-September) and elevated lipids levels in the diploid oysters. In contrast, triploid oysters only displayed a 4.81% to 5.43% increase in PAH content within their tissue during the winter and early spring months (November-early May).

The use of triploid oysters as a biomonitoring tool is feasible for assessing environmental impacts following chemical or oil spills. A caged triploid oyster monitoring system is a viable alternative to indigenous diploid bivalves throughout the year.

CHAPTER 1. GENERAL INTRODUCTION

Many organic and inorganic chemical contaminants have the capacity to persist in the environment, bioaccumulate in tissues, and are toxic to surrounding organisms. The major classes of chemical compounds found in the aquatic environment are pesticides, dioxins, polychlorinated hydrocarbons (PCBs), and polycyclic aromatic hydrocarbons (PAHs) [1]. Once these contaminants are released into the environment, the molecules interact with the atmosphere, water column, sediment, and biota. Their interactions in the environment are regulated by several physical and chemical processes, and the final result may be the chemical release, immobilization, or their biotransformation into more reactive molecules, which are more effectively available to biota[2].

The Deepwater Horizon oil spill occurred on 20 April 2010 in the Gulf of Mexico approximately 40 miles offshore and 130 miles southeast of New Orleans, Louisiana. It was the largest accidental marine oil spill in the history of the petroleum industry within the United States. The oil flowed from a sea-floor oil gusher at a depth of approximately 5,000 feet and was not plugged until 15 July 2010. The damaged well released an estimated 4.9 million barrels (2.06×10^8 gallons), causing extensive damage to marine and wildlife habitats and the Gulf's fishing (commercial and recreational) and tourism industries[3]. According to the satellite images, the spill directly impacted 68,000 square miles (180,000 km^2) of the Gulf of Mexico[4]. Researchers concluded that subsurface plumes of dissolved oil and gas would likely remain confined to the northern Gulf of Mexico and that the peak impact on the aquatic ecosystem would be delayed and long lasting[5]. Approximately one year after plugging the leak, official reports indicated about

491 miles (790 km) of coastline in Louisiana, Mississippi, Alabama and Florida were contaminated by oil and a total of 1,074 miles (1,728 km) had been oiled since the spill began[22].

Several studies have reported evidence of increased PAH concentrations in seafood after oil spills compared with baseline levels. For example, the concentration of two- to six-ring PAHs in scallops after the *Braer* oil spill off the coast of the Shetland Islands was found to be > 1,300 ppb versus 12–90 ppb in baseline samples[6]; after the *Sea Empress* oil spill off the coast of Wales, concentrations ranged from 12 to 186 ppb in salmon samples compared with pre-spill samples ranging from 9 to 86 ppb[7]. A review of PAH levels in reference data sets and post–oil spill seafood across 19 studies found average total PAH concentrations between 20 and 1,600 ppb in baseline monitoring studies and between 104 and 27,400 ppb after various oil spills[8].
During the one-year period following the Deepwater Horizon oil spill, multiple studies and reports[9,10,11] determined that PAH levels in fish, shrimp, crab, and oyster samples collected from the northern Gulf of Mexico were below the level of concern (LOC) levels established under the protocol for reopening federal and state waters. A study conducted along the Mississippi Gulf Coast observed there was no significant concentration difference between PAHs detected in the oyster samples for the *Deepwater Horizon* spill study and the 10-year historical data from the NOAA Mussel Watch program[15]. The investigators observed concentration increases in oyster tissue during the winter growth months (Nov-Dec 2010) and declines during the spawning months (Jun-Aug 2011).

Mussels and related bivalves species are good bioindicators of water and sediment quality because they are sedentary and have the ability to bioconcentrate a great variety of environmental pollutants[12]. Unfortunately, enhanced stress and extreme changes in biochemical composition during spawning season (May-August) may make bivalves unreliable as bioindicators of pollutants in the aquatic environment. In the early 1980's aquaculture scientist were busy developing a hybrid oyster that was sterile and grew consistently throughout the year. This new "triploid" oyster would allow aquaculture biologist to rear larger, healthier oysters for consumption the whole year round. Triploid oysters may be the answer to biomonitoring and the seasonal variation phenomenon. So, why are triploid oysters good candidates for biomonitoring organic contaminants in the aquatic environment? Triploids are unique in that they are functionally sterile and do not spawn. While diploid oysters spawn out in warmer months and become watery with little meat yield, triploid oysters retain their meat in the form of glycogen all summer long. Triploids also do not expend energy on reproduction, and as a result, grow faster and larger than normal diploid oysters. Since triploids do not undergo the transformations associated with reproduction that make diploid oysters loose tissue mass during the summer months, they can be used year around to effectively biomonitor chemical constituents in coastal waters and sediments. Normal diploid oysters typically reduce tissue mass by approximately 50-60% during the summer months, making them ineffective as biomonitoring tools for those months and in long-term studies[13]. Triploid oysters are hypothesized to be superior to diploid oysters as a biomonitoring tool because; (1) triploids are a more robust species; (2) triploids are naturally resistant to pathogens; and (3) triploids do not use up their stored glycogen

during the spawning season, retaining contaminants for a longer period of time. The triploid oyster offers the Louisiana oyster industry a remarkable new opportunity to rebuild their dwindling oyster resources. Due to triploids inherent capacity to retain larger amounts of contaminants, more research needs to be conducted regarding their ability to bioconcentrate and metabolize (depurate) organic contaminants.

1.1 Goals and Hypotheses

The goal of this dissertation was to study the effects of seasonal variation on caged diploid and triploid oysters and their ability to biomonitor pollutants in the aquatic environment. Current studies indicate that indigenous or caged diploid oysters may not give an accurate assessment of contaminant levels in the aquatic environment while undergoing reproductive development. Although the deployment of caged oysters may be more time sensitive and dependent, the use of caged triploid oysters to consistently estimate the levels of contamination within an area will allow federal and state regulators to accurately make decisions concerning seafood safety and estuary sustainability.

Many questions have arisen when discussing the attributes of bivalves as biomonitoring tools during chemical or oil spills in the aquatic environment. It has been argued that traditional QuEChERS methods are not adequate for detecting high molecular weight PAHs in bivalves and seafood tissue[14,47]. As stated earlier, research has shown that indigenous diploid oysters are stressed and weakened during their spawning season, making them questionable candidates for biomonitoring studies during the summer months[15,16]. In contrast, triploid oysters have shown healthy and

constant throughout the entire year[96]. The preceding statements suggest the following hypotheses for this research study:

Hypothesis 1:

H_A: The traditional QuEChERS extraction and dispersive solid-phase extraction method is not adequate for the determination of PAHs in the Eastern oyster.

H_O: The traditional QuEChERS extraction and dispersive solid-phase extraction method is adequate for the determination of PAHs in the Eastern oyster.

Hypothesis 2:

H_A: Triploid Eastern oysters are more effective than diploid Eastern oysters for biomonitoring PAH uptake in the summer months during short-term laboratory exposure studies.

H_O: Triploid Eastern oysters are less effective than diploid Eastern oysters for biomonitoring PAH uptake in the summer months during short-term laboratory exposure studies.

Hypothesis 3:

H_A: Triploid Eastern oysters are more effective than diploid Eastern oysters for biomonitoring PAH uptake in the summer months during long-term field exposure studies.

H_O: Triploid Eastern oysters are less effective than diploid Eastern oysters for biomonitoring PAH uptake in the summer months during long-term field exposure studies.

In order to quantify the hypotheses suggested for this research, the exposure of diploid and triploid oysters to oiled sediments was quantitated to determine the feasibility of using triploid oysters to biomonitor pollutants in the aquatic environment. A modified extraction method was developed and validated for gas chromatography with mass spectrometry (GC/MS) analysis of selected PAHs in oyster and seafood tissue, using PAH percent recovery to verify method efficacy. Diploid and triploid oysters were evaluated as pollution bioindicators in the laboratory by exposing them to multiple levels of South Louisiana crude oil contaminated sediments over a 3-week bioaccumulation period. PAH uptake in tissue was quantitated using a modified extraction and GC/MS methodology. A field study was conducted in the Bay Jimmy and Grand Isle regions of the Barataria Bay Estuary system utilizing caged diploid and triploid oysters. The Bay Jimmy area was heavily oiled during the *Deepwater Horizon* oil spill and some areas were intentionally left untouched by cleanup operations to facilitate future oil spill research. Water quality parameters, sediment, and oyster tissue were quantitated over a 15-month period to determine if there was a significant concentration difference between PAHs detected in the caged diploid oyster and triploid oyster tissues.

1.2 Literature Review

1.2.1 Polycyclic Aromatic Hydrocarbons (PAHs) in the Environment

Polycyclic aromatic hydrocarbons (PAHs) are commonly occurring environmental contaminants that are formed during incomplete combustion of petroleum, coal, and other organic fuels[17]. The high temperature reactions during the combustion process lead to the formation of unsubstituted (parent) compounds as well as methylated PAHs. As a result, complex mixtures of parent and methylated PAHs are found in the environment following oil spills. Contamination of the aquatic environment by these chemicals is of major concern because of their mutagenic/ carcinogenic properties. They are often more carcinogenic than the parent compound and their carcinogenic activity varies with the position of the methyl substituent in the aromatic nucleus. The carcinogenic effects of the methylated PAHs are due to the metabolic conversion of the parent hydrocarbon to specific electrophilic metabolites, which readily react with cellular macromolecules, including DNA[18].

PAH inputs to the coastal marine environment are primarily from two sources: (a) the movement of water containing dissolved and particulate constituents derived from watersheds; and (b) atmospheric deposition both in precipitation and dry deposition into the coastal ocean[19]. PAHs have been observed to be most concentrated in estuaries and coastal environments near urban centers, where inputs from the watersheds and airsheds are most concentrated. The major sources of PAHs to the coastal marine environment include urban runoff, wastewater effluents, industrial outfalls, atmospheric deposition, and spills and leaks during the transport and production of crude and refined fuel oils.

Some of these compounds are environmentally important because they are, or can become, carcinogenic or mutagenic. The US Environmental Protection Agency (EPA) has identified 16 PAHs as particularly important due to their toxicity to mammals and aquatic organisms[20]. In addition, methylated polycyclic aromatic hydrocarbons (methylated PAHs) are commonly occurring environmental contaminants. The 16 priority pollutant PAHs and several methylated (substituted) PAHs, are the primary focus of this research (Table 1.1). These compounds have 2–6 fused rings and molecular weights (MWs) of 128-278 g/mol. Solubility and vapor pressure characteristics of PAHs are the major physical/chemical factors that control their distribution between the soluble and particle components of the atmosphere, hydrosphere, and biosphere. Solubility values range from highly insoluble (e.g. benzo[ghi]perylene, 0.003 mg/L) to slightly soluble (e.g. naphthalene, 31 mg/L) and vapor pressures range from highly volatile (naphthalene) to relatively nonvolatile (dibenzo[a,h]anthracene). These compounds range from moderately to highly lipophilic, having logarithmic octanol–water partition coefficients (log *Kow*) of 3.37–6.75.

1.2.2 The Deepwater Horizon Oil Spill and the Barataria Bay Estuary

The Deepwater Horizon oil spill began on 20 April 2010 in the Gulf of Mexico on the BP-operated Macondo Prospect. Following the explosion and sinking of the *Deepwater Horizon* oil rig, a sea-floor oil gusher flowed for 87 days, until it was capped on 15 July 2010. The U.S. Government estimated the total discharge at 4.9 million barrels (210 million U.S. gal; 780,000 m^3). In July, tar balls reached Grand Isle and the

Table 1.1 Target parent and methylated PAHs monitored during study.

PAH	MW	# Rings	PAH	MW	# Rings
Naphthalene	128	2	3,6-dimethylphenanthrene	206	3
Benzothiophene	134	2	Fluoranthene	202	5
2-methylnaphthalene	142	2	Pyrene	202	4
Biphenyl	154	2	Benzo(a)fluorene	216	5
2-ethylnaphthalene	141	2	1-methylpyrene	216	4
Acenaphthylene	150	3	Benzo(a)anthracene	228	4
Acenaphthene	154	3	Chrysene	228	4
Dibenzofuran	168	3	5-methylchrysene	242	4
Fluorene	166	3	Benzo(b)fluoranthene	252	5
Dibenzothiophene	184	3	Benzo(k)fluoranthene	252	5
Phenanthrene	178	3	Benzo(e)pyrene	252	5
Anthracene	178	3	Benzo(a)pyrene	252	5
Carbozole	167	3	Perylene	252	5
4-methyldibenzothiophene	198	3	Indeno(1,2,3-cd)pyrene	276	6
2-methylphenanthrene	192	3	Dibenz(a,h)anthracene	278	6
2-methylanthracene	192	3	Benzo(g,h,i)perylene	276	6
1-methylphenanthrene	192	3			

shores of Lake Pontchartrain. As of July 2011, about 491 miles (790 km) of coastline in Louisiana, Mississippi, Alabama and Florida were contaminated by oil and a total of 1,074 miles (1,728 km) had been oiled since the spill began. As of December 2012, 339 miles (546 km) of coastline remain subject to evaluation and/or cleanup operations[21]. The Bay Jimmy area was reported as having received a significant amount of oil from the BP oil spill – over 32,000 gallons of oil were removed during a 10-day period of cleaning. Coastal erosion, a major environmental challenge even before the spill, became a bigger problem when oil washed onto the northern Barataria Bay islands, killing the roots of marsh grass and mangrove trees that helped to hold the land together[125].

Following the *Deepwater Horizon* oil spill eight U.S. national parks were threatened and more than 400 species that live in the Gulf islands and marshlands were at risk, including the endangered Kemp's Ridley turtle, the Green Turtle, the Loggerhead Turtle, the Hawksbill Turtle, and the Leatherback Turtle[22]. In the national refuges most at risk, about 34,000 birds were counted, including gulls, pelicans, roseate spoonbills, egrets, terns, and blue herons[23]. A comprehensive 2009 inventory of offshore Gulf species counted 15,700. The area of the spill includes 8,332 species, including more than 1,200 fish, 200 birds, 1,400 molluscs, 1,500 crustaceans, 4 sea turtles, and 29 marine mammals. In December 2013, the journal *Environmental Science & Technology* published a study finding that of 32 dolphins briefly captured from 24-km stretch near southeastern Louisiana, half were seriously ill or dying from liver disease, pneumonia, loss of teeth, and one pregnant female was carrying a dead fetus[24]. A 2014 study of the effects of the oil spill on bluefin tuna, published in the journal *Science*, found that oil already broken down by wave action and chemical dispersants was more toxic than fresh oil[25].

1.2.3 Triploid Oysters

Triploids carry three sets of chromosomes while natural diploid oysters are born with only two sets, making them diploids. Triploids grow much faster, and since they don't spawn, oysters can be harvested year round. Stanley et al.[26,27] first discovered the culturing technique in 1979 while carrying out research at the University of Maine. The original triploid protocol (Figure 1.1A) involved the exposure of a toxic chemical, a mycotoxin, cytochalasin B, to the newly fertilized egg, using dimethylsulfoxide (DMSO)

as a solvent. The cytochalasin B was introduced at a critical moment during meiosis to prevent the reduction of the two sets of the female chromosomes to one, so that it would end up with three sets (triploidy). Timing, duration and dosage levels were crucial and could in worst cases cause genetic abnormalities (aneuploidy) and high mortalities at various stages of larval development. Experimentation with the procedure determined optimal yields were produced when the toxic chemical was used during the meiosis II stage, inhibiting the release of the second polar body and thus producing a triploid zygote (fertilized egg)[28]. After growing concerns about the use of cytochalasin B and its links with cancer, researchers tried various methods to produce triploids. These methods involved subjecting oyster eggs to hydrostatic pressure, temperature extremes, and using an alternative to cytochalasin B, 6-dimethylaminopurine (6-DMAP)[29,30,31]. Like the cytochalasin B procedure, these methods resulted in high mortality and a tendency for the triploid oysters to revert back to diploids as they developed. In the early 1980s a new procedure (Figure 1.1B) for producing triploids was developed by Allen and a colleague, Ximing Guo[32]. The procedure involved breeding a male tetraploid oyster (with four sets of chromosomes) with a natural female diploid, producing a “natural” triploid, and thus avoiding the use of any toxic and cancerous chemical. These “natural” triploids were after only 9 months of growth as much as 50% larger than normal diploid oysters. Because triploid oysters are sterile, they don’t breed and become “milky” during the regular breeding season like diploids. The energy not used for reproduction results in faster growth rates, while maintaining stable biochemical composition (e.g. lipid, glycogen, and protein) throughout the year.

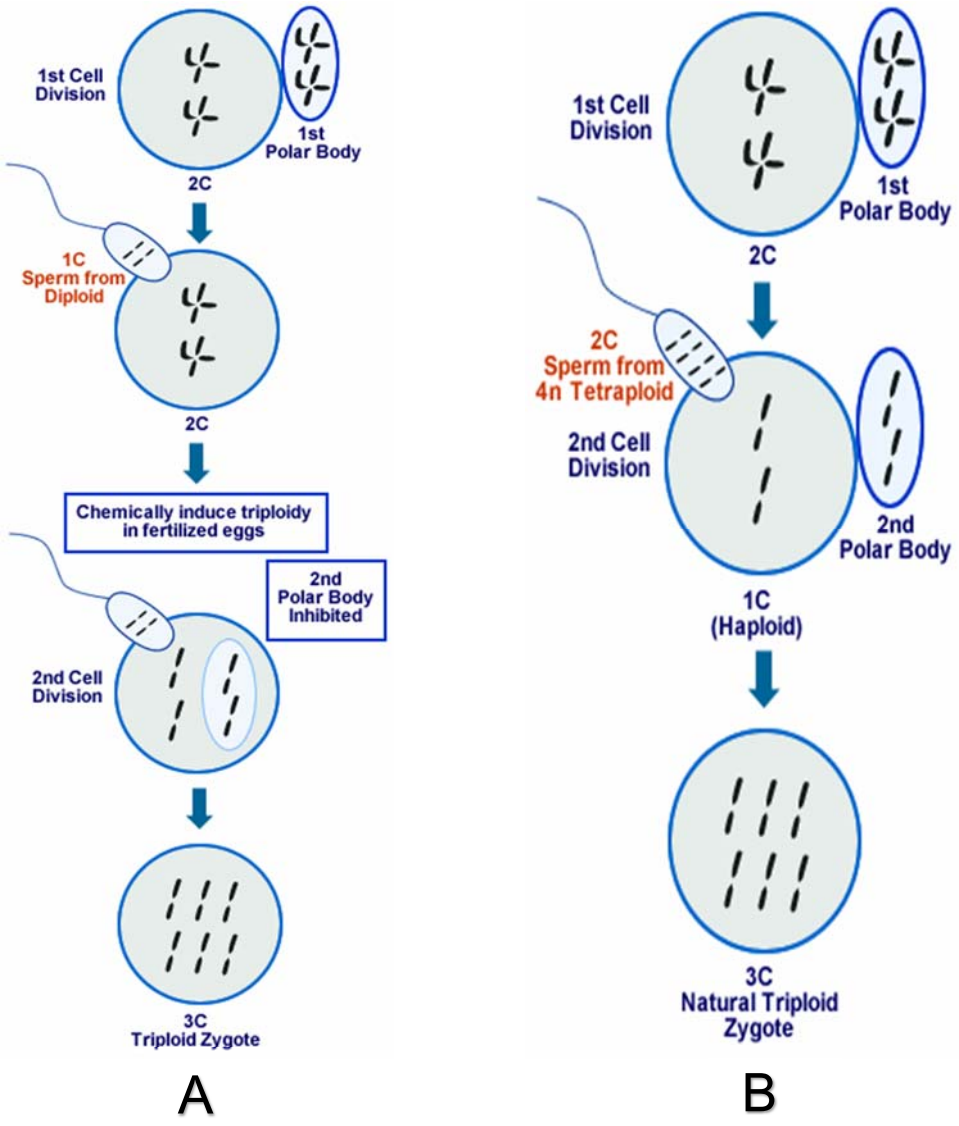

Figure 1.1 Reproductive development of triploid oyster using cytochalasin B procedure (A) and natural tetraploid procedure (B)[33].

1.2.4 Oysters as Bioindicators of Pollution

The National Oceanic and Atmospheric Administration (NOAA) was one of the first governmental agencies to promote long-term monitoring of contaminants in the aquatic environment. In 1985 NOAA established a Mussel Watch Project covering all

U.S. coastal regions as part of the National Status and Trends (NS&T) Program[34]. The overall goal of the Mussel Watch Project is to monitor and record the status and long-term changes in pollutant (e.g. PAHs) concentrations in coastal and estuarine ecosystems from sediments and bivalves collected throughout select U.S. coastal regions. The sediment and bivalve results from this program have provided estimates of temporal trends and geographic distribution of chemical concentrations along our coastal waterways for over 25 years.

Bivalves are a priority species for study because they are biomonitors of nature and readily assess biological and environmental impacts of aquatic pollutants. The utility of oysters as environmental sentinels is associated with their sessile and filter-feeding habitat. Because of their immobility, bivalves are more likely to come into contact with contaminated sediments, thus allowing them to bioaccumulate more contaminant than other mobile aquatic species. As filter feeders, bivalves integrate environmental conditions over time. Due to their elementary digestive and enzyme system, they have a limited capacity of metabolizing contaminants, thus increasing the concentration of contaminants in their tissues above the background levels found in the ambient environment[35].

The duration of elevated PAH levels in seafood after previous oil spills has varied from several weeks to several years. High-molecular-weight PAHs (those with four or more benzene rings) are more likely to accumulate in tissues and persist for longer periods than low-molecular-weight PAHs[36]. PAH levels in tissue after previous oil spills have been consistently lower in vertebrates compared with invertebrates[37]. Aquatic vertebrates can metabolize PAH and PAH metabolites more rapidly than invertebrates

due to their relatively well-developed cytochrome P-450 monooxygenase enzyme system[38,39], a system that results in increased metabolic clearance of PAH relative to bivalve mollusks, which have limited PAH metabolic capability, and crustacean[40].

Bivalves have been utilized throughout the world to assess the effects of oil spills on biota and their surrounding environment. In June 1994, approximately 400 barrels of Venezuelan Recon was spilled at the Port of Acajutla, El Salvador[41]. Chemical dispersants were used in shallow waters to remove the oil from the water's surface. Samples of oysters from the area of dispersed oil contained total PAH levels of 147-164 ppm (dry weight), compared with background levels less than 1.0 ppm. PAH levels were reduced by 94-98% after a 4-week period. Caged diploid mussels were used to evaluate the bioavailability of contaminates at various locations within Arcachon Bay, France[42]. Results from the study showed that caged mussel exposed to sediments with contamination levels <2000 µg/Kg were contaminated at moderate levels (300-500 µg/Kg), while those exposed to sediment contamination >3000 µg/Kg had accumulated more total PAHs (>2000 µg/Kg). A recent oyster study[43] at known oil-exposed sites in Louisiana showed no PAH contamination or biological signs of exposure to oil 6 months after the *Deepwater Horizon* oil spill. It was possible that oysters, which typically slow or cease feeding under stress (environmental or reproductive), may have stopped feeding when exposed to oiled material. The results suggest that oyster feeding and subsequent growth was not significantly affected by oil exposure.

1.2.5 Evaluation of Oyster Extraction Methodology

Prior to the Deepwater Horizon oil spill, the gas chromatography with mass spectrometry (GC/MS) methods employed for tissue analysis involved time-consuming and laborious cleanup techniques in order to remove co-extracts that cause chromatographic interferences in capillary column analyses[44]. The standard procedures typically require 5-6 days for 2 to 3 analysts to analyze 15-20 samples. Due to the large geographic area affected and length of the oil spill, new fast and sensitive methods were developed to accommodate the large number of samples collected. The QuEChERS (quick, easy, cheap, effective, rugged, and safe) method was originally developed for the determination of pesticide residues in fruits and vegetables using an acetonitrile solvent and subsequent liquid-liquid partitioning extraction. Sample cleanup was achieved with a dispersive solid-phase (dSPE) extraction to remove polar interferences and water. Shortly after the spill, attempts were made using the original QuEChERS for extraction of seafood tissue, but results indicated the method was not effective at recovering the high molecular weight (HMW) PAHs[45]. Several studies have been conducted investigating the use of various solvent combinations and extraction techniques (e.g. sonication and dSPE) in order to enhance PAH recoveries. Forsberg et al.[39] used a modified QuEChERS method for determination of PAHs in high-fat smoked salmon with an ethyl acetate, acetone, and isooctane solvent combination. Recoveries for the HMW PAHs were significantly higher in comparison to the traditional methodology. Johnson[38] varied dSPE combinations while determining PAHs in edible seafood using QuEChERS-based extraction and gas chromatography-tandem mass

spectrometry. The method recoveries were 71%-130% over the PAH range with relative standard deviations (RSDs) less than 14%.

The Hansen solubility parameter approach used in this study for predicting organic solvent solubility has been widely used in the polymer and pharmaceutical fields. The basis of Hansen solubility parameter (HSP) is that the total energy of vaporization of a liquid consists of several individual interactions. These interactions consist of (atomic) dispersion forces, (molecular) permanent dipole-permanent dipole forces, and (molecular) hydrogen bonding (electron exchange)[46]. The dispersion forces, permanent dipole-permanent dipole forces, and hydrogen bonding are represented by δ_d, δ_p, and δ_h, respectively. Hansen used a simplified three-dimensional model to plot polymer solubilities. He determined, by doubling the dispersion parameter axis, an estimated sphere volume of solubility would be formed for each polymer (Figure 1.2).

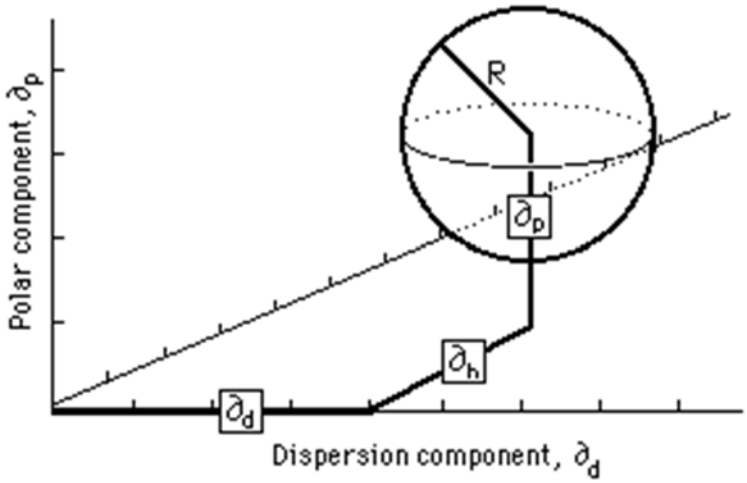

Figure 1.2 Hansen volume of solubility for a polymer.

The Hansen volume of solubility for a polymer is located within a 3-D model by giving the coordinates of the center of a solubility sphere (δ_d, δ_p, and δ_h) and its radius of interaction (R). A polymer or compound is most likely soluble in a solvent (or solvent blend) if the Hansen parameters for the solvent are within the solubility sphere for that particular polymer or compound[47]. The use of the Hildebrand Solubility Parameter as a predictor of the optimum solvent to extract POP's from environmental soil matrices has been previously reported[48]. The Hansen solubility parameters account for the Hildebrand solubility parameter as follows (eqn. 1.1):

$$\delta^2_t = \delta^2_d + \delta^2_p + \delta^2_h \qquad (1.1)$$

where δ^2_t is the total Hildebrand parameter, δ^2_d is the dispersion component, δ^2_p is the polar component and δ^2_h is the hydrogen-bonding component.

In order to plot all three parameters on a single two-dimensional graph, a certain departure must be made from Hansen solubility sphere theory. The construction of the Teas graph is based on the hypothetical assumption that all materials have the same Hildebrand value. According to this assumption, solubility behavior is determined, not by differences in total Hildebrand value, but by the relative *amounts* of the three component forces (dispersion force, polar force, and hydrogen bonding force) that contribute to the total Hildebrand value[49]. Teas parameters, also called fractional parameters, are mathematically derived from Hansen values and indicate the percent

contribution that each Hansen parameter contributes to the whole Hildebrand value (eqn. 1.2):

$$f_d = \frac{\partial_d}{\partial_d + \partial_p + \partial_h} \qquad f_p = \frac{\partial_p}{\partial_d + \partial_p + \partial_h} \qquad f_h = \frac{\partial_h}{\partial_d + \partial_p + \partial_h} \tag{1.2}$$

Figure 1.3 shows the effect of solvents on a basic Teas graph grouped according to classes. Increasing molecular weight within each class shifts the relative position of a solvent on the graph closer to the bottom right apex. This occurs because, as molecular weight increases, the polar part of the molecule that causes the specific character identifying it with its class, or functional group, is increasingly "diluted" by progressively larger, nonpolar "aliphatic" molecular segments. This gives the molecule, as a whole, relatively more dispersion force and less of the polar character specific to its class.

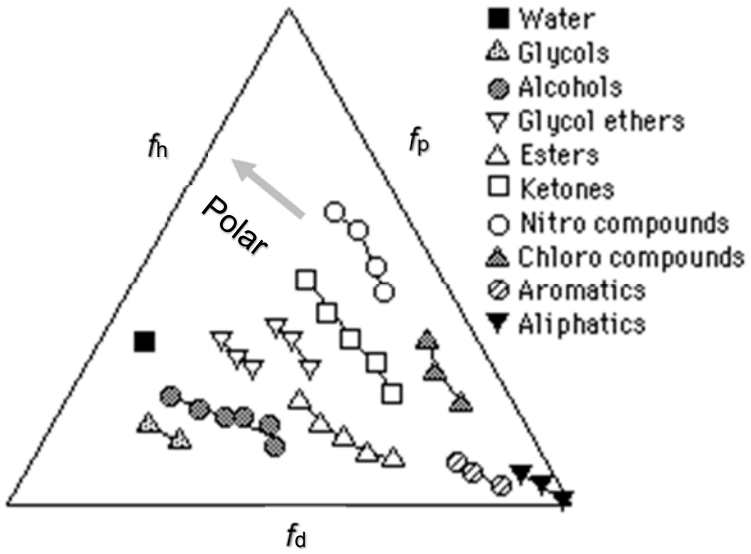

Figure 1.3 Solvents grouped according to classes in a basic Teas graph.

The Teas graph is particularly useful as an aid to formulating solvent mixtures for specific applications. Solvents can easily be blended to exhibit selective solubility behavior (dissolving one material but not another), or to control such properties as evaporation rate, solution viscosity, degree of toxicity or environmental effects. The use of the Teas graph can reduce trial and error experimentation to a minimum, by allowing the solubility behavior of a solvent mixture to be predicted in advance. Because solubility properties are the net result of intermolecular attractions, a mixture with the same solubility parameters as a single liquid will, in many cases, exhibit the same solubility behavior. Determining the solubility behavior of a solvent mixture, therefore, is simply a matter of locating the solubility parameters of the mixture on the Teas graph. There are two ways by which this may be accomplished: mathematically, by calculating the fractional parameters of the mixture from the fractional parameters of the individual solvents, or geometrically, by simply drawing a line between the solvents and measuring the ratio of the mixture on the graph. The mathematical method is the most accurate, and is appropriate for mixtures of three or more solvents. The geometrical method is the most convenient and is suitable for mixtures of two solvents, or for very rough guesses when three solvents are involved[43].

This document is presented in manuscript form. The first chapter is a general introduction and literature review. In the second chapter, the analytical method development and validation for determination of PAHs in oyster tissue is described. In the third chapter, PAH content in diploid and triploid oysters were compared following exposure to various concentration of whole SLC oil over a 3-week time period. In the four chapter, PAH levels were measured in oysters (diploid and triploid) and sediment

during a 15-month field study in the Barataria Bay Estuary. Discussion and conclusions are presented at the end of individual chapters. The literature cited is located at the end of the document.

CHAPTER 2. DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN EASTERN OYSTERS BY ENHANCED QUECHERS EXTRACTION, DISPERSIVE SOLID-PHASE EXTRACTION, AND GC/MS

2.1 Introduction

Polycyclic aromatic hydrocarbons (PAHs) and their homologue derivatives are universal environmental contaminants that typically originate from petrogenic or pyrogenic sources. PAHs are characterized by thermodynamically stable 2-6 ring molecules and are naturally found in crude oils and coal. They are also generated by the incomplete combustion or pyrolysis of hydrocarbons from anthropogenic and natural sources. Many of these compounds are suspected mutagens, teratogens, and/or carcinogens[50].

Accidental crude oil spills in our navigable waterways raise the concern for marine fauna and flora to be exposed to PAHs at higher than acceptable levels. The U.S. Food and Drug Administration (FDA) is responsible for detecting and assessing safety concerns of seafood taken from the areas exposed to spilled oil in the water and sediment. The standard protocol for assessing oil-contaminated seafood requires sensory test of petroleum taint and PAH analysis at low-ppb levels. The PAH analysis is performed on suspected seafood for targeted parent and homologue PAHs that have potential negative effects on human health[51].

As a result of the *Deepwater Horizon* oil spill, the FDA initiated the development of a high-throughput screening analytical method using the QuEChERS (Quick, Easy, Cheap, Effective, Rugged, and Safe) extraction procedure and high-performance liquid chromatography coupled with fluorescence detection (HPLC-FLD)[52]. Using QuEChERS, samples are prepared in 3 simple steps. Samples are first homogenized,

then extracted and partitioned with an organic solvent and salt solution, with the extracts finally cleaned using the dispersive solid phase extraction (dSPE) technique.

Prior to the *Deepwater Horizon* spill incident, the standardized methods employed to detect PAHs in seafood, gas chromatography with mass spectrometry (GC-MS), employed time–intensive extraction and cleanup procedures in order to remove co-extracts that produce chromatographic interferences in capillary GC analysis[53]. Common tissue extraction techniques include soxhlet extraction, sonication-assisted extraction, and accelerated solvent extraction coupled to a primary sample cleanup procedure employing solid-phase extraction, alumina/silica based column fractionation, or gel-permeation chromatography[54,55]. The standard procedure required 4-5 days for 2-3 technicians and analyst to process 15-20 samples. The massive number of seafood analyses required by the *Deepwater Horizon* spill incident revealed the need for a rapid extraction and analytical procedure with detection limits in the low part per billion (ppb) range using GC-MS instrumentation. Using the QuEChERS method, turnaround time for processing a batch of 20 homogenized seafood samples by a single analyst is reduced to less than 24 hours. Johnson demonstrated in a pilot study that GC-MS/MS detected benzo (a) pyrene standard at less than 1 ppb, indicating GC-MS/MS technology would produce approximately 10 times lower detection limits for PAHs than using LC-based technology[56]. Lehotay and others demonstrated that dispersive solid phase extraction (dSPE) cleanup using primary and secondary amine (PSA) exchange material and octadecylsilane endcapped (C18) could effectively remove lipid co-extracts from QuEChERS extracts from moderately fatty foods[57].

Originally, the QuEChERS method was developed for the determination of pesticides residues in fruits and vegetables. Just prior to and immediately after the 2010 Deepwater Horizon oil spill, several QuEChERS methods were modified and developed for the analysis of PAHs in seafood matrices[58,59]. Despite the success of QuEChERS extraction, application of the procedure to extract PAHs from high-fat fish samples at 500 ppb spiking levels produced less than 70% extraction efficiency[60]. Multiple applications of traditional QuEChERS to extract PAHs from seafood tissue has shown the extraction solvent, acetonitrile, incapable of recovering high molecular weight (HMW) components (MW>252), typically averaging less than 60-70% recovery[9,61]. Most QuEChERS methods are validated using only the 16 EPA priority pollutant PAHs required for the analysis and determination of contaminants within seafood matrices, such as bivalve tissue. Following the *Deepwater Horizon* incident, governmental and academic investigators found that low-molecular-weight parent PAHs and several substituted PAHs were present in most seafood types examined[62]. The lack of toxicological and analytical data and related risk assessment on the substituted PAHs represents an especially critical gap in the scientific data because, by mass, the substituted PAHs constitute the vast majority of PAHs in crude oil and refined petroleum products with the potential to contaminate seafood following a marine spill event[63].

Choice of a solvent or solvent mixture for the extraction of PAHs involves many factors, including evaporation rate, solution viscosity, environmental and human health concerns, water miscibility, and often the effectiveness of a solvent depends on its ability to adequately dissolve one material while leaving other materials unaffected.

Hansen solubility parameters were developed by Charles M. Hansen in 1967 as a way of predicting if one material will dissolve in another and form a solution. They are based on the idea that likes dissolves likes where one molecule is defined as being 'like' another if it bonds to itself in a similar way. Specifically, each molecule is given three Hansen parameters, each generally measured in mega-pascals ($MPa^{0.5}$):

- δ_d, The energy from dispersion forces between molecules
- δ_p, The energy from dipolar intermolecular force between molecules
- δ_h, The energy from hydrogen bonds between molecules.

These three parameters can be treated as co-ordinates for a point in three dimensions also known as the Hansen space. The nearer two molecules are in this three-dimensional space, the more likely they are to dissolve into each other. As a means to illustrate solubility information on a two dimensional graph system, Jean P. Teas developed the Teas graph in 1968. The Teas graph uses a set of fractional parameters (f_d, f_p, and f_h) mathematically derived from the Hansen solubility parameters to accurately plot solubility coordinates on a useful graph[64].

The main objective of this study was to evaluate and validate an enhanced QuEChERS method with dSPE cleanup for analyzing parent and substituted PAHs in oyster tissue at low ppb levels using GC-MS. The study was conducted on 24 parent and nine (9) substituted PAHs spiked in Louisiana harvested eastern oysters (*Crassostrea virginica*). In this study, the investigator evaluated 9 organic solvents commonly used in either sample preparation or solvent exchange (acetone, acetonitrile, cyclohexane, ethanol, ethyl acetate, dichloromethane, toluene, isooctane, and methyl

ethyl ketone). This extraction and cleanup study evaluated multiple solvent combinations, using Hansen solubility parameters, in an attempt to enhance the QuEChERS method recovery of the HMW constituents. In addition, multi-level dSPE cleanup and ultrasonic-assisted extraction techniques were evaluated to improve overall extraction and cleanup efficiency of the traditional QuEChERS method.

2.2 Method and Materials

2.2.1 Chemicals and Materials

A stock solution of 33 parent PAHs and substituted PAHs (2000 µg/ml) was prepared by combining a 17 EPA priority pollutant PAH mix, two (2) custom PAH mixes, and multiple individual PAH standards to volume with 50% Acetone/50% Dichloromethane (Table 2.1). The PAH spiking solution and instrument calibration standards were purchased from Absolute Standards, Inc. (Hamden, CT) and AccuStandard (New Haven, CT). A stock internal standard (ISTD) solution (1000 µg/ml) containing five isotope-labeled standards was purchased from AccuStandard. A stock surrogate standard (SS) solution (2000 µg/ml) containing five isotope-labeled standards was purchased from Absolute Standards, Inc. Two working spiking standards (2.0 and 20 µg/ml) were prepared by dilution of the stock PAH spiking and surrogate standard solution with 50% Acetone/50% Dichloromethane and stored in a chemical refrigerator at 4°C. An instrument calibration curve (10, 5.0, 2.5, 1.0, 0.25, and 0.10 µg/ml) of the parent and substituted PAHs was prepared by combining the stock PAH spiking solution and the surrogate standard solution in 50% acetone/50% dichloromethane and storing in a chemical refrigerator at 4°C. Approximately 5 µl of the stock ISTD solution was

added to each calibration standard and sample prior to analysis. High purity Optima (>99.8 purity) acetic acid (AA), acetonitrile (MeCN), ethyl acetate (EA), acetone (ACE), cyclohexane (CH), hexane (HEX), and pesticide grade isooctane (ISO) and dichloromethane (DCM) were purchased from Fisher Scientific (Pittsburg, PA) and used throughout the study. HPLC grade (>99.9% purity), toluene (TOL), and methyl ethyl ketone (MEK) were purchased from Sigma Aldrich (St. Louis, MO). Glacial acetic acid was purchased from J.T. Baker (Phillipsburg, NJ) and ultra-pure water was supplied by a Thermo Barnstead MicroPure water purification system (Dubuque, IA).

Commercially available Q-sep QuEChERS AOAC 2007.01 extraction salts (6 g of magnesium sulfate and 1.5 g of sodium acetate per packet) and AOAC 2007.01 sample dispersive SPE tubes (1200 mg of magnesium sulfate, 400 mg of primary secondary amines, and 400 mg of C18 per tube) were obtained from Restek Corporation (Bellefonte, PA). Thermo Scientific Nalgene Oak Ridge round-bottom 50-ml centrifuge tubes were purchased from Cole-Parmer (Vernon Hills, IL). The 5-ml amber storage and 2-ml amber crimp top autosampler were purchased from Agilent Technologies (Santa Clara, CA).

2.2.2 Oyster Sample Source and Preparation

Fresh diploid oysters were purchased from a local oyster harvester in Houma, Louisiana. The oysters were harvested from Caillou “Sister” Lake SW of Dulac, Louisiana. Average oyster lipid content (2.45%) was determined using methods described by Smeded[65]. Tissue was homogenized using a Waring 2-speed laboratory blender with a 110 ml stainless steel container (Stamford, CT). The homogenized

Table 2.1 Retention time (RT), monitored ions, and %RSD for individual analytes by GC/MS.

PAH	Chromatogram #	DB5 RT (min.)	SIM ions (*m/z*)		r^2	# Rings	Source
			Quant.	Confirm.			
Naphthalene-d8	ISTD #1	10.60	136	68	—	2	a
Naphthalene	1	10.67	128	127,129	0.998	2	b
Benzothiophene	2	10.86	134	89	0.997	2	a
2-methylnaphthalene	3	13.19	142	141,115	0.997	2	b
1-methylnaphthalene-d10	SS #1	13.45	152	151	0.994	2	b
Biphenyl	4	15.05	154	152	0.996	2	a
2-ethylnaphthalene	5	15.38	141	140	0.991	2	b
Acenaphthylene	6	16.58	152	151,150	0.996	3	b
Acenaphthene-d10	ISTD #2	17.18	164	162,160	—	3	a
Acenaphthene	7	17.30	154	153,152	0.991	3	b
Dibenzofuran-d8	SS #2	17.88	176	147	0.991	3	b
Dibenzofuran	8	17.96	168	139	0.995	3	a
Fluorene	9	19.29	166	165,167	0.994	3	b
Dibenzothiophene	10	22.48	184	139,185	0.999	3	a
Phenanthrene-d10	ISTD #3	22.88	188	94,80	—	3	a
Phenanthrene	11	22.97	178	176,179	0.996	3	b
Anthracene-d10	SS #3	23.08	188	186	0.996	3	b
Anthracene	12	23.15	178	176,179	0.994	3	b
Carbozole	13	23.89	167	139	0.985	3	a
4-methyldibenzothiophene	14	24.24	198	184	0.992	3	a
2-methylphenanthrene	15	25.04	192	191,165	0.997	3	a
2-methylanthracene	16	25.19	192	191,165	0.998	3	a
1-methylphenanthrene	17	25.45	192	191,165	0.997	3	a
3,6-dimethylphenanthrene	18	26.77	206	191,205	0.999	3	b
Fluoranthene	19	27.83	202	203,200	0.997	5	b
Pyrene	20	28.47	202	203,200	0.997	4	b
Benzo(a)fluorene	21	30.16	216	215,217	0.991	5	a
1-methylpyrene	22	30.74	216	215,217	0.999	4	b
Benzo(a)anthracene-d12	SS #4	33.16	240	238	0.996	4	b
Benzo(a)anthracene	23	33.25	228	226,229	0.997	4	b
Chrysene-d12	ISTD #4	33.30	240	236	—	4	a
Chrysene	24	33.40	228	226,229	0.999	4	b
5-methylchrysene	25	35.15	242	241,226	0.992	4	b
Benzo(b)fluoranthene	26	37.23	252	253,250	0.996	5	b
Benzo(k)fluoranthene	27	37.31	252	253,250	0.993	5	b
Benzo(e)pyrene	28	38.16	252	253,250	0.995	5	b
Benzo(a)pyrene-d12	SS #5	38.26	264	260	0.998	5	b
Benzo(a)pyrene	29	38.35	252	253,250	0.998	5	a
Perylene-d12	ISTD #5	38.57	264	260,265	—	5	a
Perylene	30	38.67	252	253,250	0.988	5	a
Indeno(1,2,3-cd)pyrene	31	43.20	276	277,274	0.991	6	b
Dibenz(a,h)anthracene	32	43.39	278	279,276	0.991	6	b
Benzo(g,h,i)perylene	33	44.31	276	277,274	0.998	6	b

[a] Accustandard (New Haven, CT)

[b] Absolute Standard, Inc. (Hamden, CT)

tissue samples were stored in amber glass jars and stored at -70°C until extraction. All sample preparation equipment and tools were washed with Alconox laboratory detergent (White Plains, NY) and water and rinsed with ultra-pure water, acetone, and hexane prior to use and between samples. In addition to the above cleaning procedure, all glassware and metal equipment was dried at 90°C in a Thermo Scientific low-temperature drying oven prior to use.

2.2.3 Solvent Selection Process

To determine the effect of solvent on the recovery of PAHs from oyster tissues, a series of solvent mixtures were evaluated as alternative solvents to replace the 99% MeCN -1% AA solvent mixture for the QuEChERS protocol. The investigator based the solvent selection process on solubility theories and values derived from Hildebrand and Hansen[15]. Hansen solubility parameters are both reasonably accurate in predicting solubility behavior of target compounds (e.g. PAHs) and concise in their representation of that information. The chemical properties and solubility parameters of the selected solvents, lipid, and common PAHs are listed in Table 2.2. Hansen solubility parameters were then converted to fractional solubility parameters for insertion into Teas graphs. The Teas graph is the most convenient method by which solubility information can be illustrated. The Teas graph for the selected solvents, lipids, and common PAHs is shown in Figure 2.1.

Because the final solvent selection would be based on fractional parameters and Teas graphs, the investigator used an online computational program and excel spreadsheet to systematically compare the fraction parameters for all binary (2 solvent)

and ternary (3 solvent) combinations. Using the 9 selected solvents, 36 binary and 84 ternary solvent combinations were available for comparison in the preliminary solvent recovery study. Each solvent combination was subdivided into 10% solvent gradients per solvent, producing 396 binary (36 combinations x 11 gradients) and 4,536 ternary (84 combinations x 54 gradients) theoretical solvent combinations. So as to narrow down the selection for acceptable solvent combinations, fractional solvent parameters for individual combinations were compared to the average PAH fractional solvent parameters and ranked by average percent difference. The closer the average PAH's fractional parameters proximity to the solvent system's fractional parameters, the more soluble the PAH becomes in the solvent system. Because of the large number of solvent combinations available for selection, a preliminary solvent efficacy study was performed on a select number (<10) of solvent combinations and a final solvent efficacy study was performed on the most effective solvent combination (preliminary study), using the traditional QuEChERS protocol, and seafood QuEChERS protocol.

2.2.4 Preliminary Solvent Efficacy Study

For the preliminary efficacy study, the standard QuEChERS extraction procedure (AOAC official 2007.01 method) was performed. The preliminary efficacy study extraction procedure is as follows: (1) weigh 15.0 g ± 0.1 g of homogenized oyster tissue sample into a clean 50 ml Teflon centrifuge tube; (2) fortify tissue with a 75 µl of 20 µg/ml working standard solution directly onto the oyster tissue matrix (100 ng/g) and vortex for 2 minutes (min) @ 2,000 revolutions per minutes (rpm); (3) protect from UV light and let stand for 30 minutes; (4) add 15 ml of the selected solvent combination and

Table 2.2 Chemical properties and solubility parameters of the selected solvents, lipid, and common PAHs.

Solvent/Compound	ID	Formula	MW (g/mol)	BP (°C)	Density (g/ml)	H_2O solubility (g/100g)	Polar index	δ_d	δ_p	δ_h	δ_t	$100*f_d$	$100*f_p$	$100*f_h$
Naphthalene	NAP	$C_{10}H_8$	128	218	1.025	3.16E-03	—	19.2	2	5.9	20.2	71	7	22
Anthracene	ANT	$C_{14}H_{10}$	178.2	340	1.29	4.40E-06	—	21.8	4.5	3.7	22.6	73	15	12
Perylene	PER	$C_{20}H_{12}$	252.3	400	1.36	Insoluble	—	25.4	5.9	2.9	26.2	74	17	8
Benzo-pyrene	BP	$C_{20}H_{12}$	252.3	495	1.24	6.20E-07	—	25.4	5.9	2.9	26.2	74	17	8
Pyrene	PYR	$C_{16}H_{10}$	202.3	404	1.27	1.35E-05	—	23.5	5.8	3.7	24.5	71	18	11
Chrysene	CHR	$C_{18}H_{12}$	228.3	448	1.27	Insoluble	—	23.7	4.7	2.9	24.3	76	15	9
Average PAH	AVG	—	—	—	—	—	—	23.3	5.2	3.4	24.1	73	16	11
Lipid (@ 23°C)	LIP	—	—	—	—	—	—	17.7	2.7	4.4	18.4	71	11	18
Acetone	ACE	C_3H_6O	58.08	56.2	0.786	Miscible	5.1	15.5	10.4	7.0	20.0	47	32	21
Acetonitrile	MeCN	C_2H_3N	41.05	81.6	0.786	Miscible	5.8	15.3	18	6.1	24.4	39	45	16
Cyclohexane	CH	C_6H_{12}	84.16	80.7	0.779	<0.1	0.2	16.8	0	0.2	16.8	94	2	4
Ethanol	EOH	C_2H_6O	46.07	78.5	0.789	Miscible	5.2	15.8	8.8	19.4	26.5	36	18	46
Ethyl Acetate	EA	$C_4H_8O_2$	88.11	77.1	0.897	8.3	4.4	15.8	5.3	7.2	18.2	51	18	31
Dichloromethane	DCM	CH_2Cl_2	84.93	103.3	1.324	15.8	3.1	18.2	6.3	6.1	20.2	59	21	20
Toluene	TOL	C_7H_8	92.14	110.6	0.867	0.05	2.4	18.0	1.4	2.0	18.2	80	7	13
Isooctane	ISO	C_8H_{18}	114.2	99.1	0.692	<0.1	0.1	14.3	0.0	0.0	14.3	100	0	0
Acetic Acid	AA	$C_2H_4O_2$	60.05	118	1.049	Miscible	6.2	14.5	8.0	13.5	21.4	40	22	38
Methyl Ethyl Ketone	MEK	$C_4H_8O_2$	72.11	79.6	0.805	27.5	4.7	16.0	9.0	5.1	19.1	53	30	17

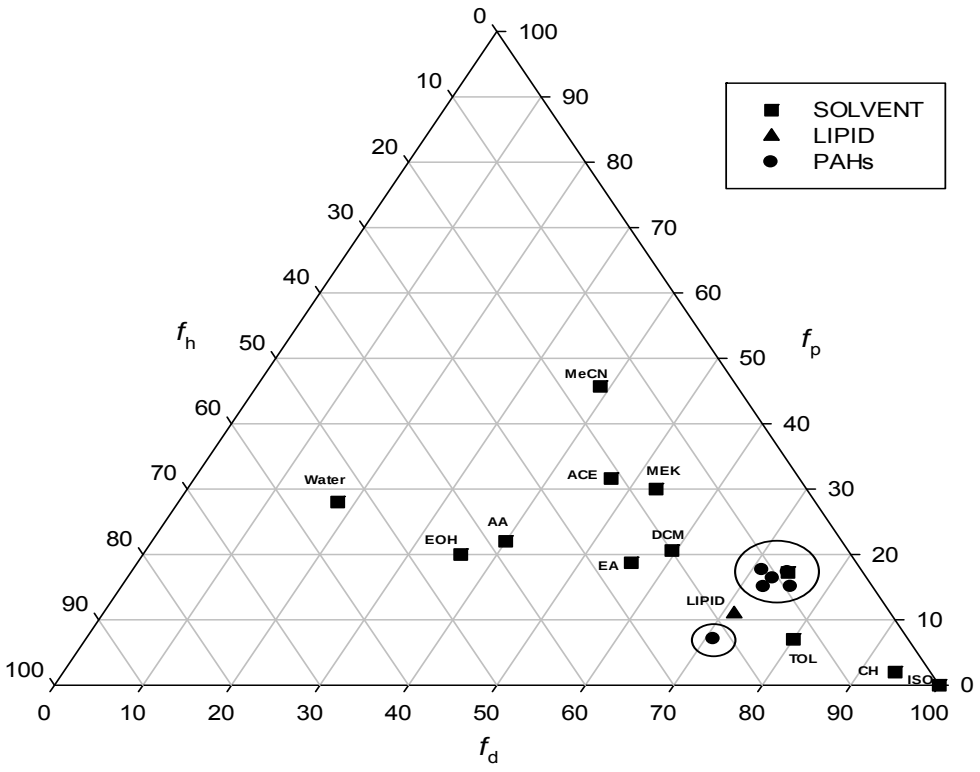

Figure 2.1 Teas graph for the selected solvents, lipids, and common PAHs.

vortex for 2 min @ 2,000 rpm; (5) add the contents of a Restek Q-sep QuEChERS AOAC 2007.01 extraction salts packet to 50-ml centrifuge tube, immediately shake for 1 min, then vortex for 2 min; (6) centrifuge the tube at 5,000 rpm for 5 min (Sorvall Instruments RT6000, Thermo Scientific, Waltham, MA); (7) transfer 8 ml of the solvent extract to a Restek Q-sep Q351 dSPE 15-ml cleanup tube and vortex for 30 seconds; (8) centrifuge for 1 min at 6,000 rpm; (9) transfer 1 ml of the solvent extract to a 2-ml amber autosampler vial, add internal standard, cap and store in 4°C refrigerator until analysis. Three reagent blanks were prepared per extraction batch by using 15 g of deionized water in place of the tissue matrix. PAH concentrations found in the reagent blanks were averaged and subtracted from sample results. Triplicate extractions were conducted for each solvent combination. The efficacy of the study was determined by performing statistical analysis of the mean of the total average PAH percent recoveries for the individual solvent combinations.

2.2.5 Final Solvent Efficacy Study

For the final solvent efficacy study, the standard QuEChERS extraction procedure (AOAC official 2007.01 method) was performed. The final solvent efficacy study extraction procedure is as follows: (1) weigh 15.0 g ± 0.1 g of homogenized oyster tissue sample into a clean 50 ml Teflon centrifuge tube; (2) fortify tissue with a 75 µl of 2.0 µg/ml working standard solution directly onto the oyster tissue matrix (10 ng/g) and vortex for 2 minutes (min) @ 2,000 revolutions per minutes (rpm); (3) protect from UV light and let stand for 30 minutes; (4) add 15 ml of the selected solvent combination and vortex for 2 min @ 2,000 rpm; (5) add the contents of a Restek Q-sep QuEChERS

AOAC 2007.01 extraction salts packet to 50-ml centrifuge tube, immediately shake for 1 min, then vortex for 2 min; (6) centrifuge the tube at 5,000 rpm for 5 min; (7) transfer 8 ml of the solvent extract to a Restek Q-sep Q351 dSPE 15-ml cleanup tube and vortex for 30 seconds; (8) centrifuge for 1 min at 6,000 rpm; (9) transfer 1 ml of the solvent extract to a 2-ml amber autosampler vial, add internal standard, cap and store in 4°C refrigerator until analysis. Three reagent blanks were prepared per extraction batch by using 15 g of deionized water in place of the tissue matrix. PAH concentrations found in the reagent blanks were averaged and subtracted from sample results. Triplicate extractions were conducted for each solvent combination. The efficacy of the study was determined by performing statistical analysis of the mean of the total average PAH percent recoveries for the individual solvent combinations.

2.2.6 Ultrasonic-Assisted Extraction Study

After the optimum solvent combination had been selected, the optimum length of time and amplitude for sonication was determined. The ultrasonic-assisted extraction study incorporated a 3x4 factorial design using time (2, 4, and 6 min) and amplitude (shaken, 25%, 50%, and 75%). The ultrasonic-assisted extraction process consisted of a programmed regime of 1 minute sonication, followed by 30 seconds of idleness, then repeat of the process. For example, the 4 minute ultrasonic-assisted process consisted of (1) 1 minute sonication, followed by (2) 30 seconds of idleness, repeat steps 1 and 2 two more times, and finally sonicate for 1 minute. A 30 second idleness period was included in the sonication process so as not to induce thermal vaporization of the low molecular weight PAH components. In addition to the optimum solvent combination, the

traditional and seafood QuEChERS protocol were included in the sonication extraction study. For the ultrasonic-assisted extraction study, the following stepwise procedure was followed: (1) weigh 15.0 g ± 0.1 g of homogenized oyster tissue sample into a clean 50 ml Teflon centrifuge tube; (2) fortify tissue with a 75 µl of 2.0 µg/ml working standard solution directly onto the oyster tissue matrix (10 ng/g) and vortex for 2 minutes (min) @ 2,000 revolutions per minutes (rpm); (3) protect from UV light and let stand for 30 minutes; (4) add 15 ml of the optimum or selected solvent combination and vortex for 2 min @ 2,000 rpm; (5) add the contents of a Restek Q-sep QuEChERS AOAC 2007.01 extraction salts packet to 50-ml centrifuge tube, immediately shake for 1 min, then vortex for 2 min or follow the specified sonication regime; (6) centrifuge the tube at 5,000 rpm for 5 min; (7) transfer 8 ml of the solvent extract to a Restek Q-sep Q351 dSPE 15-ml cleanup tube and vortex for 30 seconds; (8) centrifuge for 1 min at 6,000 rpm; (9) transfer 1 ml of the solvent extract to a 2-ml amber autosampler vial, add internal standard, cap and store in 4°C refrigerator until analysis. Three reagent blanks were prepared per extraction batch by using 15 g of deionized water in place of the tissue matrix. PAH concentrations found in the reagent blanks were averaged and subtracted from sample results. Triplicate extractions were conducted for each sonication regime. The efficacy of the study was determined by performing statistical analysis of the mean of the total average PAH percent recoveries for the individual solvent combinations.

2.2.7 Co-Extraction Clean-up Study

Following the selection of the optimum sonication regime, the optimum dSPE co-extract clean-up regime was determined. The degree of clean-up in extracts using the optimum solvent and sonication regime was assessed in the same empirical procedure[8,66,67] as performed by previous investigators through gravimetric measurements and determination of matrix effect on spike recoveries. For the quantitative PAH measurements, the following stepwise procedure was followed: (1) weigh 15.0 g ± 0.1 g of homogenized oyster tissue sample into a clean 50 ml Teflon centrifuge tube; (2) fortify tissue with a 75 µl of 2.0 µg/ml working standard solution directly onto the oyster tissue matrix (10 ng/g) and vortex for 2 minutes (min) @ 2,000 revolutions per minutes (rpm); (3) protect from UV light and let stand for 30 minutes; (4) add 15 ml of the optimum solvent combination and vortex for 2 min @ 2,000 rpm; (5) add the contents of a Restek Q-sep QuEChERS AOAC 2007.01 extraction salts packet to 50-ml centrifuge tube, immediately shake for 1 min, then sonicate for 4 minutes; (6) centrifuge the tube at 5,000 rpm for 5 min; (7) transfer various volumes (6.4, 8.0, and 10.7 ml) of the solvent extract to a standard Restek Q-sep Q351 dSPE 15-ml clean-up tube and vortex for 30 seconds; (8) centrifuge for 1 min at 6,000 rpm; (9) transfer 1 ml of the cleaned solvent extract (PAH quantitation) to a 2-ml amber autosampler vial, add internal standard, cap and store in 4°C refrigerator until analysis. Gravimetric measurements were achieved by following the above step-wise extraction procedure without the addition of working standard solution. A 5 ml aliquot of the cleaned solvent extract (gravimetric measurement) was transferred to a pre-weighed glass test tube. Moisture was removed from the pre-weighed test tubes by heating the tubes for 1 hour

at 110°C prior to weighing. All extracts in the gravimetric tubes were taken to dryness using nitrogen stream evaporation and the tubes were again heated at 110°C for 1 hour to remove moisture from the glassware prior to weighing on a calibrated analytical balance. The weight difference was recorded to determine the amount of co-extract in the initial and final extracts. Three reagent blanks were prepared per extraction batch by using 15 g of deionized water in place of the tissue matrix. PAH concentrations found in the reagent blanks were averaged and subtracted from sample results. Five replicate extractions were conducted for the PAH quantitation and gravimetric determination. The efficacy of the study was determined by performing statistical analysis of the mean of the total average PAH percent recoveries for the optimum solvent combination and gravimetric measurements.

2.2.8 Enhanced Extraction Protocol

The overall effectiveness of the enhanced QuEChERS method was determined by incorporating the results and information collected from the solvent efficacy, ultrasonic-assisted extraction, and co-extraction clean-up studies and comparing to the traditional QuEChERS methodology. For the enhanced extraction study, the following stepwise procedure was followed: (1) weigh 15.0 g ± 0.1 g of homogenized oyster tissue sample into a clean 50 ml Teflon centrifuge tube; (2) fortify tissue with a 75 µl of 2.0 µg/ml working standard solution directly onto the oyster tissue matrix (10 ng/g) and vortex for 2 minutes (min) @ 2,000 revolutions per minutes (rpm); (3) protect from UV light and let stand for 30 minutes; (4) add 15 ml of the optimum solvent combination and vortex for 2 min @ 2,000 rpm; (5) add the contents of a Restek Q-sep QuEChERS

AOAC 2007.01 extraction salts packet to 50-ml centrifuge tube, immediately shake for 1 min, then sonicate for approximately 4 minutes; (6) centrifuge the tube at 5,000 rpm for 5 min; (7) transfer 6.4 ml of the solvent extract to a Restek Q-sep Q351 dSPE 15-ml cleanup tube and vortex for 30 seconds; (8) centrifuge for 1 min at 6,000 rpm; (9) transfer 1 ml of the solvent extract to a 2-ml amber autosampler vial, add internal standard, cap and store in 4°C refrigerator until analysis. Three reagent blanks were prepared per extraction batch by using 15 g of deionized water in place of the tissue matrix. PAH concentrations found in the reagent blanks were averaged and subtracted from sample results. Triplicate extractions were conducted for each enhanced extraction procedure. The efficacy of the study was determined by performing statistical analysis of the mean of the total average PAH percent recoveries for the individual solvent combinations.

2.2.9 GC-MS Analysis

All calibration standards and samples were analyzed using an Agilent GC-MS system equipped with a 7890A GC and 5975C MS detector (Santa Clara, CA) operating in positive ion mode with electron impact ionization (70 eV). Mass spectral data were acquired utilizing selective ion monitoring (SIM) mode and DB-5MS capillary column (30 m length, 0.25 µm film thickness, 0.25 mm i.d., Agilent J&W). The injection port was operated in the pulsed splitless mode, fitted with a 2 mm glass liner with deactivated glass wool, and delivered a 1 µl injection via an Agilent 7683B Series autosampler to an inlet maintained at 280 °C. The chromatographic conditions were the following: He carrier gas constant flow 1.0 ml/min, the initial oven temperature was 70 °C, 2 min hold,

ramp to 280 °C at 6 °C/min, 3 min hold, and ramp to 300 °C at 3 °C/min for a final run time of 46.67 min. Mass spectrometer transfer line, source, and quadruple temperature were 280 °C, 230 °C, and 150 °C, respectively. PAH SIM quantitation and confirmation ion are presented in table 2-1 along with retention times and percent relative standard deviation (% RSD).

2.2.10 LOD and LOQ determination for parent and substituted PAHs

Limits of detection (LODs) and limits of quantitation (LOQs) for the enhanced QuEChERS method were determined according to 40 CFR 136 B for the oyster tissue matrix[68]. Seven replicates of 5 ppb level spikes were analyzed using a working PAH spike and surrogate spike solution. Then, the standard deviations of the recovered concentrations of the seven replicate spikes were calculated. The LOD for each individual component was determined at 99% confidence level by multiplying the standard deviation by 3.71 and the LOQ was determined by multiplying the standard deviation by 10.

2.2.11 Statistical Analysis

Statistical significance was assessed using an independent t-test, one-way analysis of variance (ANOVA), and two-way ANOVA (IBM SPSS Statistics Version 22, USA). Differences between groups or treatments were considered significant when $p < 0.05$ (two-tailed).

2.3 Results and Discussion

2.3.1 Chromatographic Analysis

The analytical protocol and chromatographic conditions developed for the detection and quantitation of the 33 parent and substituted PAHs used in these studies were optimized based on previous works[69, 70] and produced an acceptable degree of separation of the target compounds (Figure 2.2), with retention times in the range of 10.6 to 44.3 minutes. Table 1 summarizes parent/ substituted PAH and deuterated internal/ surrogate standard GC/MS instrumental parameters. Carbozole and perylene were the only PAH compounds that had a correlation of determination (r^2) less than 0.991. All other PAH standard components had coefficients ≥ 0.991 within the calibration range of 0.10-10 µg/ml, demonstrating excellent method linearity. The presence of matrix effects (e.g. lipids) is a known problem when working with marine tissue and can have a significant impact on the detection and quantification of target compounds by chromatography. Matrix effects can reduce or magnify the analytical response when compared to the same concentration in a matrix-free solution. In this study, the investigator was able to demonstrate the reduction of matrix effects while achieving target PAH recoveries of >89%.

The LOD and LOQ (Table 2.3) for the target parent and substituted PAH components were determined according to 40 CFR 136 B for the oyster tissue matrix. LODs ranged between 1.2 µg/Kg wet weight for phenanthrene and 2.1 µg/Kg wet weight for indeno (1, 2, 3-cd) pyrene, with corresponding LOQs in the range 3.2-5.7 µg/Kg wet weight. In respect to the maximum levels of concern for seafood established by the Food and Drug Administration (FDA), the LOQs attained by the enhanced

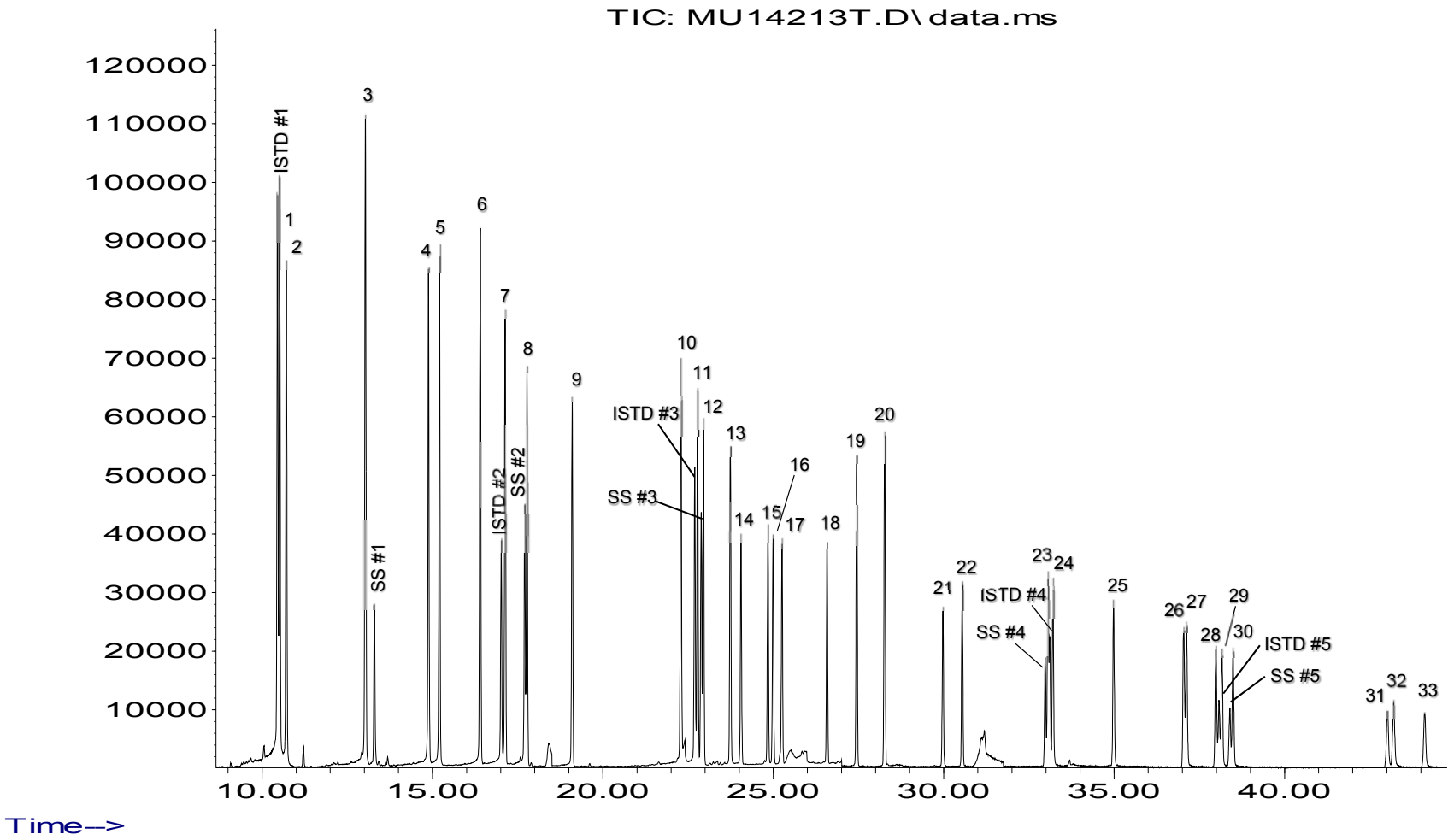

Figure 2.2 Representative selective ion monitoring (SIM) total ion current (TIC) chromatogram for PAHs in oyster tissue with a 100 ng/g level spike. PAHs corresponding to chromatogram numbers are listed in Table 2.

Table 2.3 Enhanced QuEChERS method limit of detection (LOD) and limit of quantitation (LOQ) in comparison to FDA PAH levels of concern.

PAH	LOD	LOQ	FDA levels of concern[a]	PAH	LOD	LOQ	FDA levels of concern[a]
	(µg/Kg)		(µg/Kg)		(µg/Kg)		(µg/Kg)
Naphthalene	1.8	4.9	133,000	1-methylphenanthrene	1.7	4.6	NA
Benzothiophene	2.0	5.4	NA	3,6-dimethylphenanthrene	1.5	4.0	NA
2-methylnaphthalene	1.9	5.1	NA	Fluoranthene	1.8	4.9	267,000
1-methylnaphthalene-d10	2.0	5.4	NA	Pyrene	1.6	4.3	200,000
Biphenyl	1.7	4.6	NA	Benzo(a)fluorene	1.5	4.0	NA
2-ethylnaphthalene	2.0	5.4	NA	1-methylpyrene	1.7	4.6	NA
Acenaphthylene	1.9	5.1	NA	Benzo(a)anthracene-d12	1.6	4.3	NA
Acenaphthene	2.0	5.4	NA	Benzo(a)anthracene	1.9	5.1	1,430
Dibenzofuran-d8	1.9	5.1	NA	Chrysene	1.5	4.0	143,000
Dibenzofuran	1.7	4.6	NA	5-methylchrysene	1.9	5.1	NA
Fluorene	1.3	3.5	267,000	Benzo(b)fluoranthene	2.0	5.4	1,430
Dibenzothiophene	1.4	3.8	NA	Benzo(k)fluoranthene	1.8	4.9	14,300
Phenanthrene	1.2	3.2	2,000,000[b]	Benzo(e)pyrene	2.0	5.4	NA
Anthracene-d10	1.9	5.1	NA	Benzo(a)pyrene-d12	2.1	5.7	NA
Anthracene	2.0	5.4	NA	Benzo(a)pyrene	2.0	5.4	143
Carbozole	1.7	4.6	NA	Perylene	1.9	5.1	NA
4-methyldibenzothiophene	1.8	4.9	NA	Indeno(1,2,3-cd)pyrene	2.1	5.7	1,430
2-methylphenanthrene	1.6	4.3	NA	Dibenz(a,h)anthracene	2.0	5.4	143
2-methylanthracene	1.8	4.9	NA	Benzo(g,h,i)perylene	1.9	5.1	NA

[a] Values obtained from U.S. FDA (2010)

[b] Summed values for phenathrene and anthracene

QuEChERS extraction and cleanup method are sufficiently low enough for the method to be used for practical environmental monitoring of PAH uptake by bivalves.in the aquatic environment.

2.3.2 Solvent Efficacy Study

Table 2.4 summarizes the solvent combination selection for the preliminary and final efficacy studies and their solubility properties. A total of eight (8) binary and ternary solvent combinations were selected according to their low average percent difference ranking. In addition to the above eight solvent combinations, a traditional QuEChERS (99% MeCN–1% AA) and an existing seafood QuEChERS (40% ACE–40%

EA–20% ISO)[11] protocol were included in the preliminary and final solvent recovery studies. The locations and proximity of the preliminary efficacy study solvent combinations, in relationship to the target PAHs and lipids, are displayed in Figure 2.3. The original QuECHERS protocol by Anastassides[71] was designed for pesticide analysis of fruits and vegetables that contain greater than 75% moisture by weight. For this reason, water content is considered to be a critical parameter to be controlled during QuEChERS extraction. Various investigators have reported the independent and combined effectiveness of various ratios of acetonitrile, ethyl acetate, acetone, hexane, dichloromethane, cyclohexane, and isooctane for the multiresidual extraction of semivolatile organic compounds from solid and semisolid matrices[72,73]. The criteria of interest for this study focuses on solvent systems capable of (1) improved selectivity for the HMW nonpolar PAH components; (2) effective diffusion of the solvent into the tissue matrix; and (3) being easily evaporated so as to reduce the detection limit.

Table 2.4 Summary of solubility properties of compounds of interest and solvent systems evaluated in the preliminary and final efficacy studies.

	Solvent Mix/Compound	ID	δ_d	δ_P	δ_H	δ_t	R	RED	$100*f_d$	$100*f_p$	$100*f_h$	Avg. % Diff.*
PAHs & Lipid	Naphthalene	NAP	19.2	2	5.9	20.2	—	—	71	7	22	—
	Anthracene	ANT	21.8	4.5	3.7	22.6	—	—	73	15	12	—
	Perylene	PER	25.4	5.9	2.9	26.2	—	—	74	17	9	—
	Benzo-pyrene	BP	25.4	5.9	2.9	26.2	—	—	74	17	9	—
	Pyrene	PYR	23.5	5.8	3.7	24.5	—	—	71	18	11	—
	Chrysene	CHR	23.7	4.7	2.9	24.3	—	—	76	15	9	—
	Average PAH	AVG	23.3	5.2	3.4	24.1	15.0	—	73	16	11	—
	Lipid (@ 23°C)	LIP	17.7	2.7	4.4	18.4	—	—	71	11	18	—
Preliminary screening	40% MEK-60% TOL	1	17.2	4.4	3.2	18.1	9.77	0.65	69	16	15	6.44
	50% MEK-50% CH	2	16.4	5	2.65	17.2	13.44	0.90	74	16	10	1.58
	60% DCM-40% CH	3	16.9	4.4	4.3	18.0	12.38	0.83	73	13	14	15.3
	40% ACE, 60% CH	4	16.3	4.2	2.9	17.1	13.68	0.91	75	14	11	7.22
	50% MEK-40% CH-10% TOL	5	16.5	4.6	2.8	17.4	13.19	0.88	72	16	12	1.47
	30% ACE-30% MEK-40% CH	6	16.2	5.8	3.4	17.5	13.90	0.93	68	19	13	14.8
	20% MeCN-30% DCM-50% CH	7	16.9	5.5	3.2	18.1	12.39	0.83	73	16	11	1.49
	20% MeCN-40% TOL-40% CH	8	16.7	5.8	2.5	17.9	12.88	0.86	77	13	10	6.46
	40% ACE-40% EA-20% ISO	9	15.4	6.3	5.7	17.6	15.64	1.04	59	20	21	35.1
	99% MeCN-1%AA	10	15.3	17.9	6.2	24.3	20.53	1.37	39	45	16	64.3
Final screening	40% ACE-40% MEK-20% CH	6A	16.0	7.8	5.2	18.5	—	—	59	25	16	—
	30% ACE-30% MEK-40% CH	6B	16.2	5.8	3.4	17.5	13.90	0.930	68	19	13	—
	10% ACE-20% MEK-70% CH	6C	16.5	2.8	2.0	16.9	—	—	81	11	8	—
	50% ACE-40% EA-10% ISO	9A	15.5	7.3	6.4	18.3	—	—	54	23	23	—
	40% ACE-40% EA-20% ISO	9B	15.4	6.3	5.7	17.6	15.64	1.04	59	20	21	—
	30% ACE-30% EA-40% ISO	9C	15.1	4.7	4.3	16.4	—	—	69	15	16	—
	99% MeCN-1%AA	10	15.3	17.9	6.2	24.3	20.53	1.37	39	45	16	—

* Compared to avg. PAH

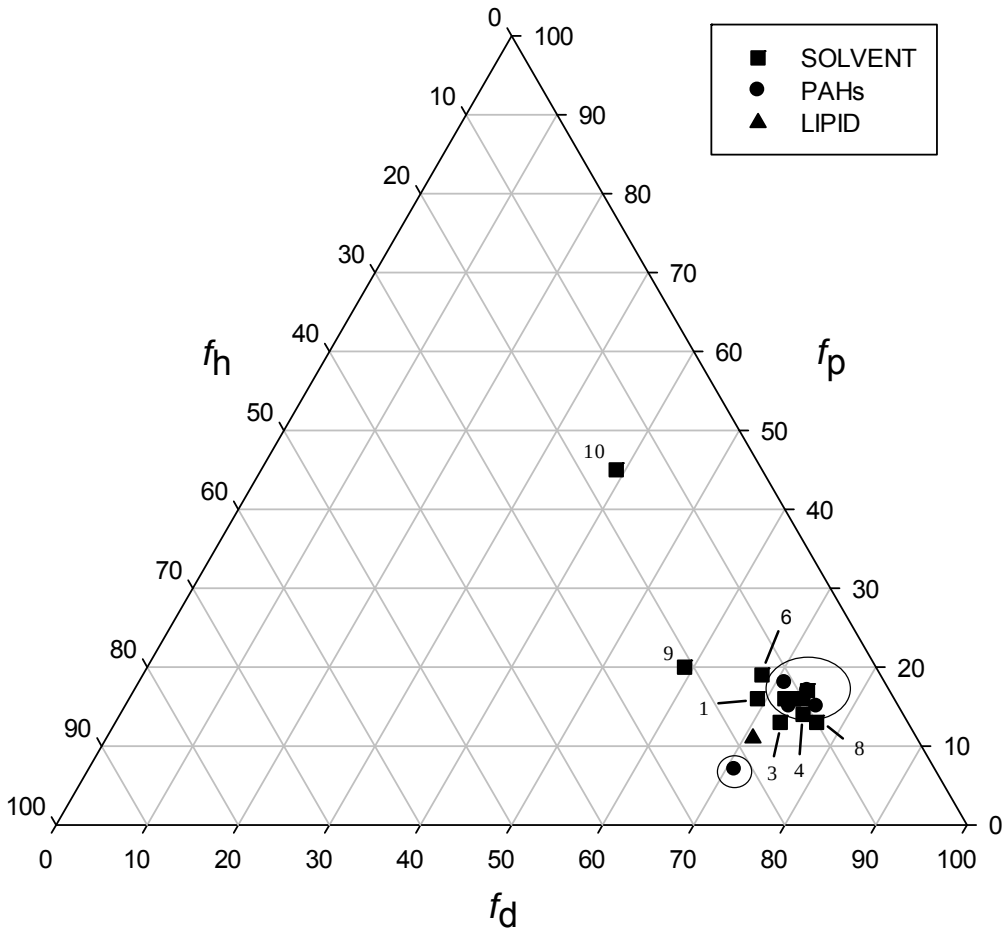

Figure 2.3 Locations and proximity of the preliminary efficacy study solvent combinations in relationship to the target PAHs and lipids.

Figure 2.4 summarizes the overall average total PAH recoveries for the 10 solvent combinations spiked at the 100 ppb level (wet weight) during the preliminary efficacy study. The solvent combinations (SCs) ranged from 61.7 to 85.1% average total PAH recovery. Solvent combinations 1, 5, 6, 7, and 9 achieved recoveries greater than 70%, while SC-6 was the only solvent system capable of achieving a recovery greater than 80%. Recoveries from oyster tissue using SC-6 (30% ACE–30% MEK-40% CH) yielded high recoveries, on average 85.1%, with individual PAH recoveries ranging from 67.6-98.1%. The 2nd highest recovery (79.5%) was the existing seafood

QuEChERS (SC-10, 40% ACE–40% EA–20% ISO) solvent system. Recoveries from oyster tissue using the traditional QuEChERS solvent system (99% MeCN–1% AA) yielded low recoveries, on average less than 66.3%, with individual PAH recoveries ranging from 45.2-81.4%. A summary of the tabulated PAH recoveries for the preliminary efficacy study (Table A.1) is located in the appendix.

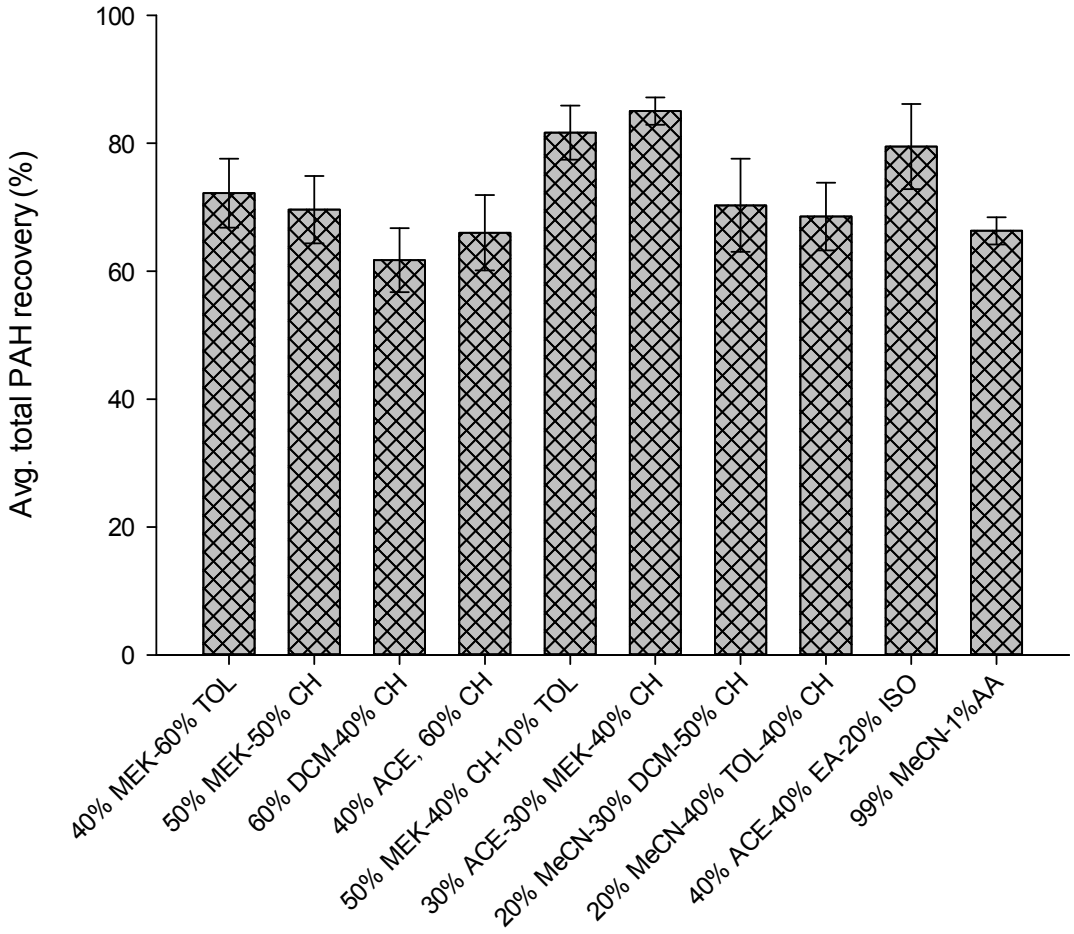

Figure 2.4 Comparison of average total PAH recoveries for the 10 solvent combinations spiked at 100 ng/g (n=3) during the preliminary efficacy study. Error bars represent standard deviation.

There was a statistically significant difference between solvent groups (preliminary efficacy study) as determined by one-way ANOVA (F (9, 20) = 6.382, p<0.0005). A Tukey post-hoc test revealed there were no significant differences between solvent combinations 1, 5, 6, and 9 (p >0.132). Solvent combinations 1, 2, 3, 4, 7, and 8 were eliminated from the solvent selection process as a result of low recoveries (<75%). Solvent combination 5 had an overall average PAH recovery greater than 75%, but was eliminated due to the elevated toxicity of the toluene component. It has been demonstrated that extraction of various matrices with acetonitrile produced limited recovery of hydrophobic components[4, 22]. The lack of high recovery efficiencies for the HMW hydrophobic PAHs, in moisture-laden matrices, may be due to acetonitrile's high polarity index (5.8) and immiscibility with many non-polar solvents (e.g. hexane, isooctane, cyclohexane). Results from the preliminary efficacy study suggests that solvent systems containing moderately water-soluble components may possess physiochemical properties that allow it to infuse with the seafood tissue. At the molecular level, extraction of seafood tissue with more water miscible solvents (e.g. acetone, ethyl acetate, and methyl ethyl ketone) may displace the cytoplasmic water within the cell wall and allow higher extraction recoveries of the PAHs by the more hydrophobic organic solvents (e.g. isooctane and cyclohexane). Unfortunately, the higher extraction efficiency of the nonpolar compounds results in extraction of less desirable co-extractable components, such as lipids. Results from the preliminary efficacy study indicated that a three component solvent system of either SC-6 (30% ACE-30% MEK-40% CH) or SC-9 (40% ACE-40% EA-20% ISO) met the criteria for an enhanced QuEChERS protocol for the extraction of PAHs from oyster tissue.

The final efficacy study was designed to evaluate and compare the two most highly effective solvent systems (SC-6B and SC-9B) and identical transecting (fractional solubility parameters) solvent systems with variations in component ratios (shown in Table 2.4). The locations and proximity of the final efficacy study solvent combinations, in relationship to the target PAHs and lipids, are displayed in Figure 2.5. A comparison of PAH recoveries for solvent systems SC-6B and SC-9B, along with comparable transecting solvent systems is shown in Figure 2.6. As in the preliminary efficacy study, the traditional QuEChERS solvent system was included in the comparison.

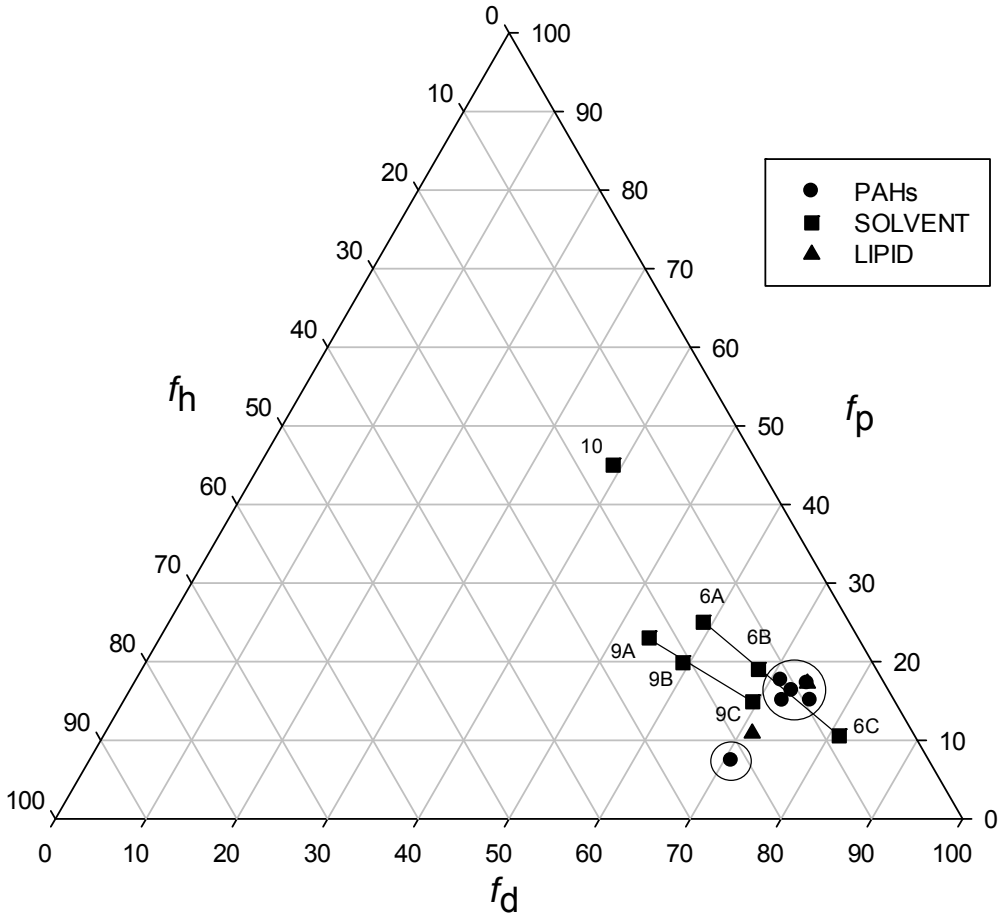

Figure 2.5 Locations and proximity of the final efficacy study solvent combinations in relationship to the target PAHs and lipids.

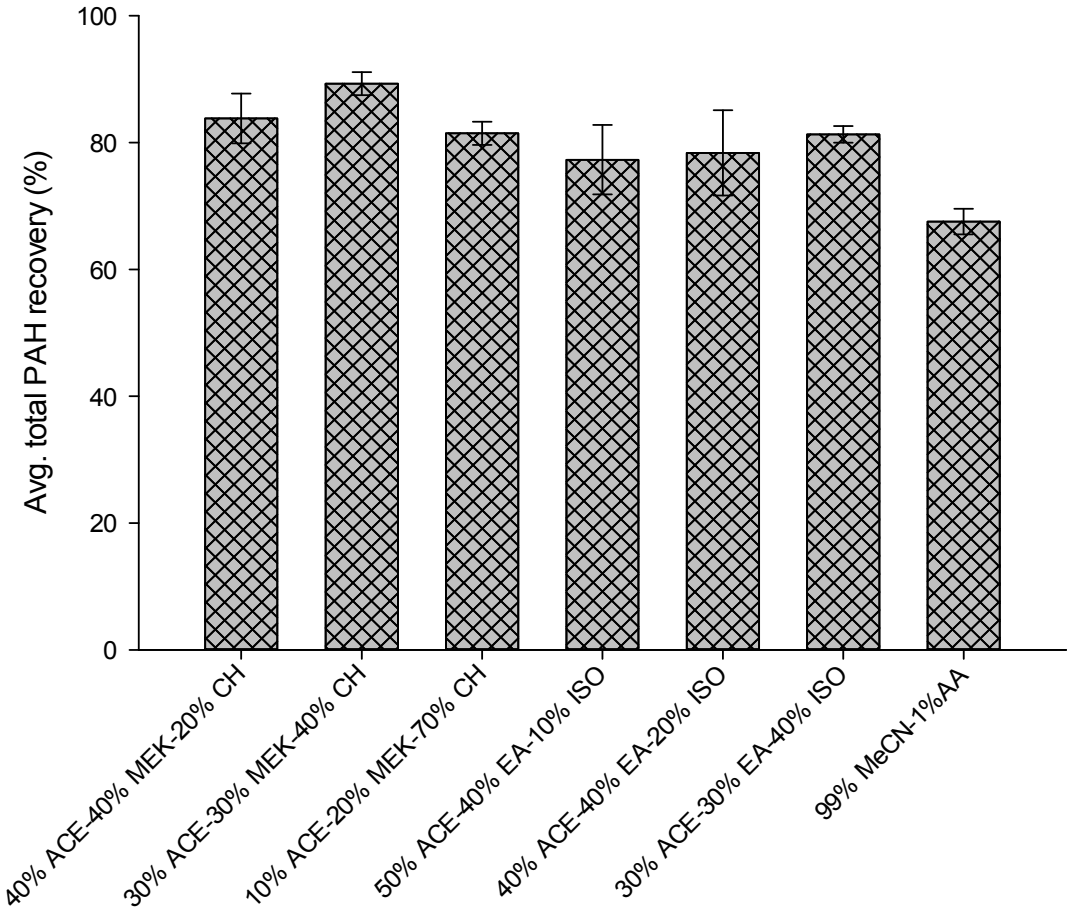

Figure 2.6 Comparison of average total PAH recoveries for the 7 solvent combinations spiked at 10 ng/g (n=3) during the final efficacy study. Error bars represent standard deviation.

The final efficacy study solvent combinations (SCs) ranged from 67.6 to 85.7% average total PAH recovery (10 ng/g, wet weight). Solvent combinations 6A-6C and 9C achieved recoveries greater than 80%, while solvent combinations 9A and 9B averaged 77.3 and 78.4 % recovery, respectively. Recoveries from oyster tissue using SC-6B (30% ACE-30% MEK-40% CH) yielded the highest recoveries, on average 85.7%, with individual PAH recoveries ranging from 75.2-96.1%. The 2nd highest recovery (83.8%) was solvent combination (40% ACE-40% MEK-20% CH). Recoveries from oyster

tissue using the traditional QuEChERS solvent system (99% MeCN-1% AA) yielded the lowest recoveries, on average less than 67.6%, with individual PAH recoveries ranging from 50.5-81.4%. There was a statistically significant difference between groups (final efficacy study) as determined by one-way ANOVA (F (6, 14) = 9.204, p<0.0005). A Tukey post-hoc test revealed there were no significant differences between solvent combination 6B and solvent combinations 6A, 6C, and 9C (p >0.213). The Tukey post-hoc test did reveal a significant difference between solvent combination 6B and solvent groups 9A, 9B, and 10 (p <0.045). A summary of the tabulated PAH recoveries for the final efficacy study (Table A.2) is located in the appendix. Results from the final solvent efficacy study indicated the 30% ACE-30% MEK-40% CH solvent system met all the criteria required for extraction of PAHs from oyster tissue.

2.3.3 Ultrasonic-Assisted Extraction Study

Based on the findings from the selection of the solvent efficacy study that 30% ACE-30% MEK-40% CH was the most effective at removing PAHs from oyster tissue, a sonication energy and time course study was performed to determine the effect of ultrasonic amplitude and sonication extraction time on PAH recoveries (10 ng/g). The results for the ultrasonic-assisted extraction study are shown in Figure 2.7. The ultrasonic-assisted extraction study treatment (time and amplitude) recovery for average total PAH recovery ranged from 78.3 to 89.1%. The lowest recovery was recorded for the 2 min-shaken treatment (78.3%), while the highest was recorded for the 4 min - 50% amplitude treatment (89.1%). A summary of the tabulated PAH recoveries for the

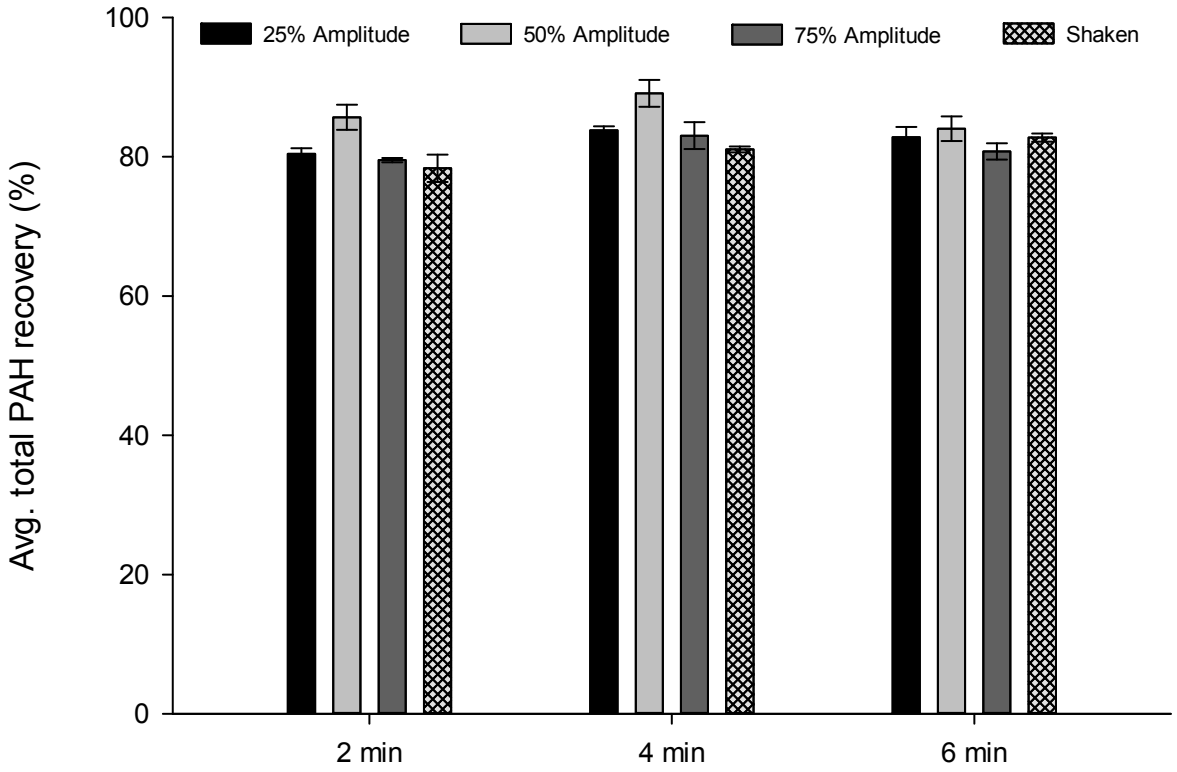

Figure 2.7 Effect of extraction time (2, 4, 6 min) and ultrasonic amplitude (shaken, 25%, 50%, and 75%) on the average total PAH recoveries for the extraction of PAHs spiked at 10 ng/g (n=3). Error bars represent standard deviation.

ultrasonic-assisted extraction study (Table A.3) is located in the appendix. The effects of sonication time (F (2, 24) = 16.77, $p < 0.0005$) and amplitude (F (3, 24) = 30.31, $p < 0.0005$) on PAH recovery were significant on average total PAH recovery during the ultrasonic-assisted extraction study. Results showed there was a significant interaction between sonication time and amplitude, (F (6, 24) = 3.787, $p < 0.0005$). A comparison of the 3 sonication times showed there were significant differences between all times. A statistical comparison of amplitude indicated there was no significant difference between shaken and 75% amplitudes ($p = 0.555$) or 25% and 75% amplitudes ($p = 0.069$). The treatments incorporating 25%, 50%, and 75% amplitude all exhibited an

increase in overall PAH recovery when the sonication time was increased from 2 min to 4 min, but displayed a decrease in overall PAH recovery when time was increased from 4 min to 6 min. The lower concentrations of PAHs recovered using the sonication process at 6 min extraction time, compared to the shaking, was due to losses of the lower molecular weight PAHs (i.e. parent and substituted naphthalenes). This may have occurred due to the elevation in solvent temperature as the result of increase in sonication times. The investigator attempted to avoid this phenomenon by incorporating a 30 sec idle period between the 1 min extraction periods, but was unsuccessful. There were significant increases in overall PAH recovery for the shaken extraction process when shaking time was increased from 2 min to 4 min and 2 min to 6 min, but no change in recoveries was noted when shaking time was increased from 4 min to 6 min. Therefore, based on these experimental results, the most effective extraction conditions, in terms of amplitude and extraction time, were 50% of ultrasonic amplitude for a 4 min time period.

2.3.4 Co-Extractive Clean-up Study

Lipids are very soluble in the selected solvent extraction system (30% ACE-30% MEK-40% CH). The lipophilic PAHs and lipids partition into the nonpolar solvent, which results in their higher recovery in the extract. The goal of this study was to evaluate the effectiveness of modifying a QuEChERS dSPE cleanup for removal of co-extracts (lipids and fats) during the extraction of oyster tissue. A modified QuEChERS oyster extract (1.0 g sample/ml) was applied on 3 different clean-up regimes; (1) 150 mg $MgSO_4$, 50 mg C18, and 50 mg PSA (traditional), (2) 188 mg $MgSO_4$, 63 mg C18, and

63 mg PSA (+25%), and (3) 113 mg MgSO4, 38 mg C18, and 38 mg PSA (-25%), and the cleaned-up extracts were injected onto a GC/MS. The +25% and -25% regimes represented a 25% increase and 25% decrease in dSPE composition (volume extract/ dSPE material weight), as compared to the traditional QuEChERS dSPE composition (150 mg MgSO4, 50 mg C18, and 50 mg PSA). The traditional, +25%, and -25% clean-up regimes were produced by inserting 8.0, 6.4, and 10.6 ml of QuEChERS oyster extract into a standard Restek Q-sep Q351 dSPE 15-ml clean-up tube, respectively. Figure 2.8 compares the total ion chromatograms (TICs) of an untreated and 3 cleaned-up extracts (30% ACE-30% MEK-40% CH solvent system and 4 min sonication at 50% amplitude). As the figure shows, the +25% clean-up procedure appears to remove more of the co-extractable matrix (by weight) than the traditional procedure. The TIC of the -25% clean-up procedure indicates this clean-up procedure removed the least amount of co-extractive matrix. The visual observations are supported by the gravimetric determinations (Figure 2.9). On average, the traditional dSPE procedure left 0.369% of co-extractives whereas the +25% dSPE procedure left 0.182% (50.7% decrease) of co-extractive in the cleaned extract. In comparison, the -25% dSPE procedure left 0.600% of co-extractive in the clean extract, a 62.6% increase in co-extractives from the +25% dSPE clean-up procedure. There was a statistically significant difference between clean-up regimes (gravimetric determination) as determined by one-way ANOVA (F (2, 14) = 52.06, p<0.0005).

Figure 2.10 graphically illustrates the results from the fortification study of oyster tissue using the QuEChERS method (30% ACE-30% MEK-40% CH solvent system and 4 min sonication at 50% amplitude) with the different dSPE clean-up regimes. As the

figure shows, the results for the traditional clean-up regime at low (10 ng/g) spiking level in oyster matrix fell within the acceptable range of 66.0-97.2% average recovery and ≤ 18.7% relative standard deviation (RSD) for quantitative PAH residue analysis. The results for the +25% clean-up regime at low (10 ng/g) spiking level in oyster matrix fell within the acceptable range of 71.7-99.8% average recovery and ≤12.9% RSD. The -25% clean-up regime was only able to achieve average PAH recoveries ranging from 60.5 to 88.7% and ≤18.7 RSD. The average total PAH recovery for the traditional, +25%, and -25% clean-up regimes were 85.7, 88.0, and 77.5%, respectively. There was a statistically significant difference between clean-up regimes (quantitative PAH) as determined by one-way ANOVA (F (2, 14) = 87.9, p<0.0005). A Tukey post-hoc test revealed there was a significant differences between the traditional and +25% clean-up regime PAH recoveries (p >0.043). The Tukey post-hoc test also revealed a significant difference between the traditional and -25% regimes (p <0.0005) and the +25% and -25% clean-up regimes (p <0.0005). A summary of the tabulated co-extractive gravimetric determinations and quantitative PAH recoveries for the co-extractive clean-up study (Tables A.4 & A.5) are located in the appendix. Based on the gravimetric and quantitative PAH results, the most effective dSPE clean-up regime was the +25% dSPE regime (188 mg MgSO4, 63 mg C18, and 63 mg PSA per ml equivalent).

2.3.5 Enhanced Extraction Protocol

The previous solvent efficacy, ultrasonic-assisted extraction, and co-extractive clean-up studies clearly indicated the newly developed enhanced QuEChERS protocol

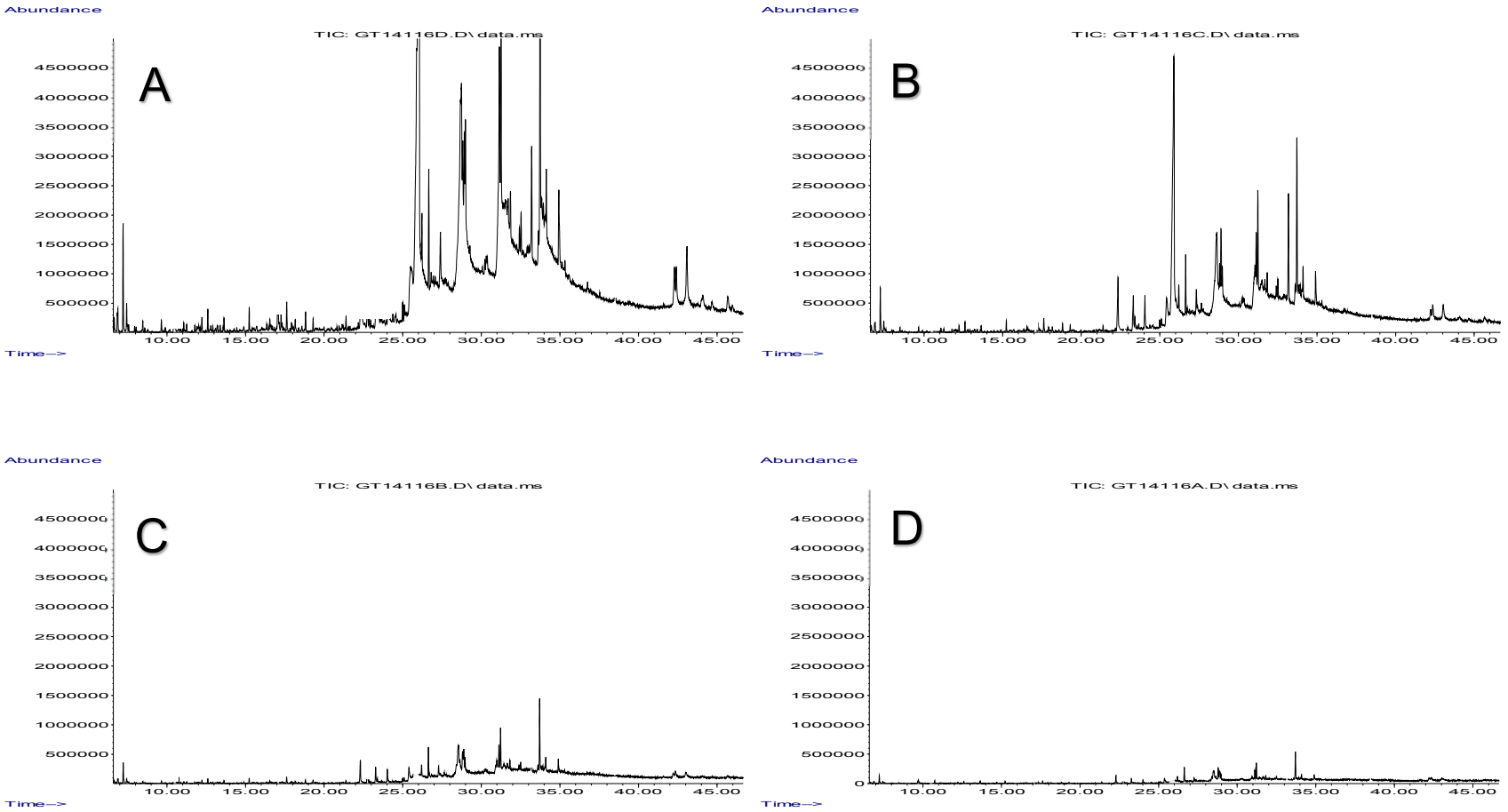

Figure 2.8 Total ion current (TIC) chromatograms of (A) enhanced QuEChERS oyster extract (1.0 g tissue/ ml equivalent) only and extract cleaned-up by (B) 113 mg MgSO4, 38 mg C18, and 38 mg PSA, (C) 150 mg MgSO4, 50 mg C18, and 50 mg PSA, and (D) 188 mg MgSO4, 63 mg C18, and 63 mg PSA.

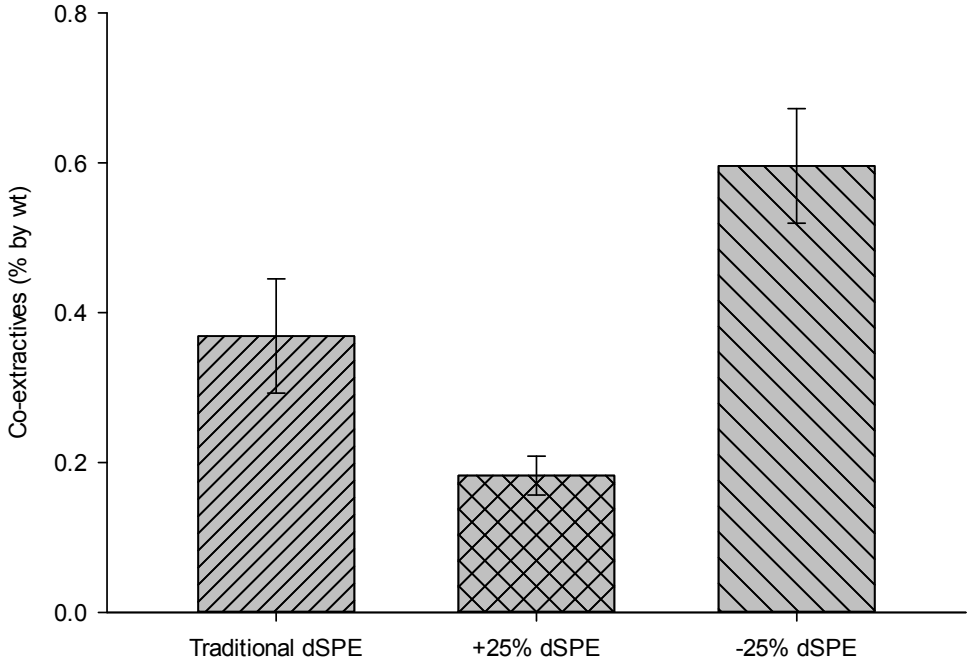

Figure 2.9 Amount of co-extractives as determined by weight differences of enhanced QuEChERS final extract taken to dryness (n=5, 5 g sample equivalents). Error bars represent standard deviation.

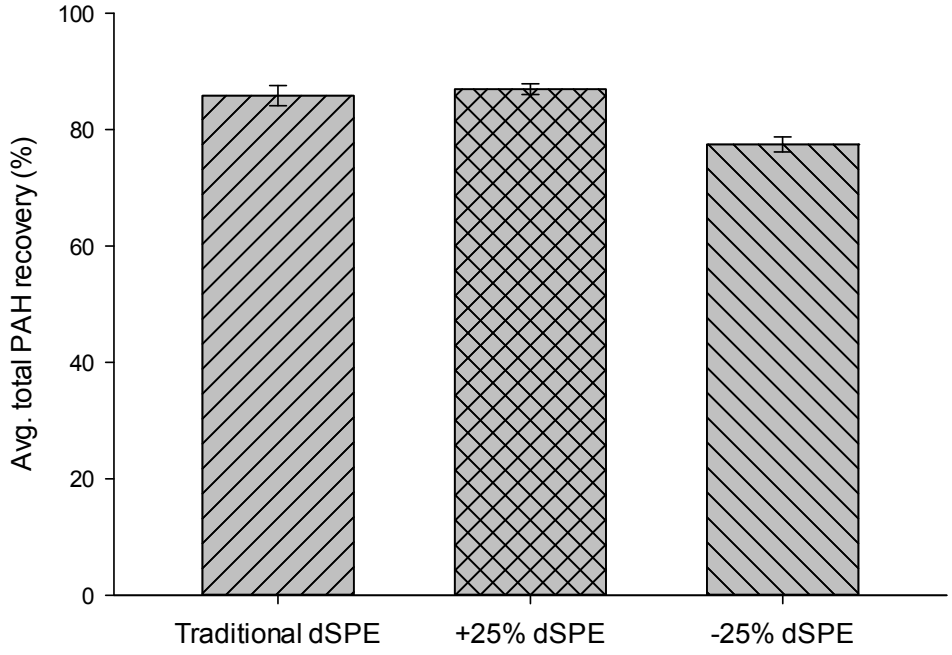

Figure 2.10 Comparison of average total PAH recoveries for the 3 clean-up regimes spiked at 10 ng/g (n=5) during the co-extractive study. Error bars represent standard deviation.

(30% ACE-30% MEK-40% CH, 4 min sonication at 50% amplitude, and 188 mg MgSO4, 63 mg C18, and 63 mg PSA per ml equivalent dSPE) yielded higher and more consistent recoveries for PAHs in oyster matrices. Figure 2.11 graphically illustrates a ring-size comparison of the average PAH recoveries obtained for traditional MeCN based QuEChERS (99% MeCN-1% AA, 2 min shaking, and 150 mg MgSO4, 63 mg C18, and 63 mg PSA per ml equivalent dSPE) and enhanced QuEChERS methods from oysters at 10 ng/g PAH spike levels. The enhanced QuEChERS method led to good recoveries, on average 89.7% over oysters tested. Noticeable performance gains were made for 3-6 ring PAHs where recoveries were improved by 22.9 to 33.8% as compared to the traditional QuEChERS method. The traditional QuEChERS method did record a 0.53% increase in parent and substituted naphthalenes recoveries when compared to the enhanced QuEChERS method. Additionally, both traditional and enhanced QuEChERS methods displayed good extraction precision with %RSDs typically less than 14.1% and 8.24%, respectively. Quantitative results for the enhanced and traditional extraction protocol (Table A.6) comparison are displayed in the appendix. As determined by an independent T-Test, this study found the traditional QuEChERS method did not have significantly different 2-ring PAH recoveries (82.8% ± 2.41%) compared to the enhanced QuEChERS method (82.4% ± 2.18%), t (4) = -0.235, p = 0.826. The statistical analysis determined the traditional method had significantly less 3-6 ring PAH recoveries compared to the enhanced method ($p < 0.003$).

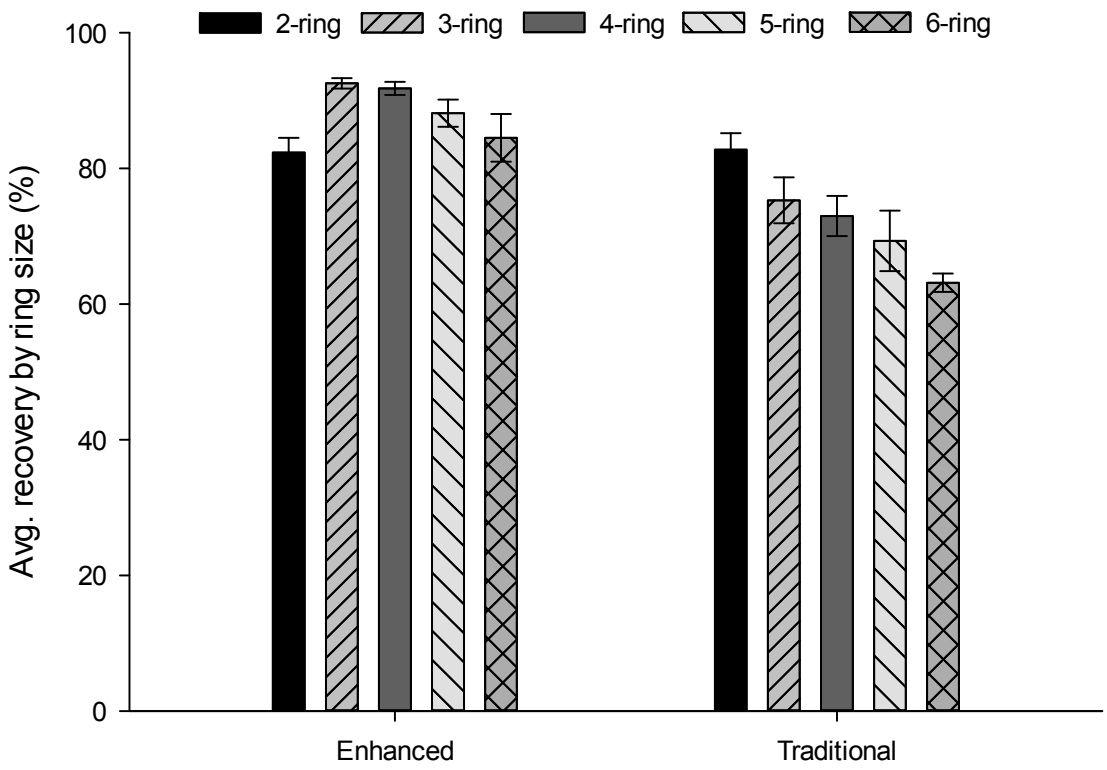

Figure 2.11 Ring-size comparison of average PAH recoveries obtained for traditional MeCN based QuEChERS and enhanced QuEChERS methods from oysters at 10 ng/g PAH spike levels (n=3). Error bars represent standard deviation.

2.4 Conclusions

The overall goal of this study was to develop and validate a fast and sensitive method for the analysis of parent and substituted PAHs in oyster tissues. The enhanced QuEChERS method performed well with regard to extraction precision (RSD < 15%) and produced results comparable to those from other studies in terms of PAH profile, resolution of chromatography, recovery range and efficiency and, together with PAH spike recovery studies, demonstrate an appropriate choice of extraction solvent is crucial to extraction performance[11, 74]. The quantitative and statistical data presented clearly indicate that an enhanced QuEChERS based analytical method incorporating a

three-component solvent system of acetone, methyl ethyl ketone, and cyclohexane in a 3:3:4 (v/v/v) ratio, along with ultrasonic-assisted extraction and dispersive SPE can be a fast, selective, and precise extraction method for determination of PAHs in oyster matrices. Results from this study decidedly reinforce the research hypothesis, that the traditional QuEChERS extraction and dispersive solid-phase extraction method is not adequate for the determination of PAHs in the Eastern oyster. The method provides GC/MS based analyte identification and quantification with detection limits at sub to low ppb levels. The enhanced QuEChERS method described in this study shows potential for use in seafood safety assessment during and after an oil spill incident.

CHAPTER 3. USE OF SHORT-TERM EXPOSURE STUDIES TO EVALUATE TRIPLOID EASTERN OYSTERS (CRASSOSTREA VIRGINICA) AS BIOINDICATORS OF POLYCYCLIC AROMATIC HYDROCARBON (PAH) CONTAMINATION IN OIL SPILL-IMPACTED AREAS

3.1 Introduction

Contamination of estuarine and navigable waterways by anthropogenic compounds is a problem throughout the United States[75]. Polycyclic aromatic hydrocarbons (PAHs) are oil and combustion-related hydrophobic contaminants found in our coastal waterways that arise from numerous anthropogenic and natural sources. These sources range from seeps in the Gulf of Mexico to large-scale deep sea releases, such as the *Deepwater Horizon* (DWH) spill in April 2010. Frequent sampling is required to accurately identify contaminant trends given the temporal and spatial variability of concentrations in water and sediment. As witnessed during the DWH spill, extensive and prolonged sampling is often very expensive and difficult to manage. A practical supplement to field sampling is the use of bivalve organisms as bioindicators for determining short-term (weeks to months) exposure concentrations in the environment following oil and chemical spills.

Indigenous or caged bivalves can provide an assay of temporal and spatial concentrations of bioavailable contaminants in the aquatic ecosystem. Bivalves are widely accepted as an effective bioindicator species for monitoring hydrophobic contaminants in the aquatic environment[76]. Bivalves have the ability to : (1) filter large volumes of seawater, incorporating dissolved and particulate-bound contaminants, (2) be easily transplanted and maintained over a long period of time, (3) tolerate a broad range of environmental conditions (e.g. temperature, salinity, and suspended solids

loading), and (4) metabolize contaminants at various rates. Various studies have shown that PAH body burden within bivalves typically decline exponentially, with a biological half-life of approximately 16 days[77,78]. The short half-life of PAHs within bivalve tissue limits their ability to serve as bioindicators to a maximum of 3-5 months after initial exposure, depending on length, frequency, and magnitude of exposure. One of the shortcomings of using natural oysters (diploid) for bioaccumulation studies is their high summer mortality rate, caused by high energy expenditure and decreased immunity during their reproductive cycle[79]. In contrast to their diploid counterparts, the inhibition of reproduction in triploid oysters has shown them to have lower summer mortality rates than diploids due to a reduced energy expenditure, a limited protein metabolism, and a more effective immune system[80]. In the summer months when diploid oysters are spawning, triploid oysters exert little energy into reproduction and remain firm, full and in excellent health. Triploids maintain their healthy conditioning during the late summer and early fall, when diploids are spawned-out, watery, and reduced in body mass. Triploids can occur naturally, but are typically manipulated through a process that causes the egg to contribute two sets of chromosomes and the sperm one set. This chromosomal configuration renders the triploid oyster essentially sterile and unable to spawn.

Seasonal trends in PAH concentrations within the bivalve population has been well documented[81,82,83,84]. In general, the uptake of hydrophobic contaminants such as PAH increases from the winter months to early spring, mainly due to gametogenesis and elevated uptake of nutrients. Spawning usually occurs in late spring to early summer, although this is highly dependent on environmental factors such as water

temperature and salinity. In diploid oysters, spawning is typically associated with a decrease in PAH burden due to a significant decrease in body mass (i.e. glycogen levels) and disruption of normal feeding patterns.

Given the amount and duration of South Louisiana crude (SLC) oil spilled in the northern Gulf of Mexico (GOM) during the DWH incident, the main goal of this study is to evaluate the triploid Eastern oyster, *Crassostrea virginica*, as an analytical tool to assess seafood contamination in oil and chemical spill impacted areas. Strong emphasis is placed on the bioaccumulation and depuration of oil-related PAHs by diploid and triploid Eastern oysters in a controlled laboratory exposure and depuration period (seven weeks). The information gathered from this study into the bioaccumulation and depuration of PAH contaminants will later be used to develop a generalized model of the environmental conditions.

3.2 Material and Methods

Mesocosm experiments were conducted at the Louisiana State University (LSU) Department of Veterinary Science aquatic facilities (Baton Rouge, Louisiana) to investigate sediment-bound PAH uptake and depuration in the Eastern oyster (*Crassostrea virginica*). The complete study consists of two individual seasonal mesocosm studies. The first exposure study was conducted February 2012 (winter) at a water temperature of 19°C ± 1°C. The second study was conducted August 2012 (summer) at a water temperature of 26°C ± 1°C. The main objective was to reproduce field conditions (sediment PAH concentrations and seasonal temperature) in the northern Barataria Bay estuary following the DWH oil spill and to monitor PAH

concentrations in Eastern oysters (triploid and diploid) following a three week exposure to SLC oil and four week depuration period. The use of laboratory-based mesocosm studies allow the concentration of sediment-bound PAHs as well as the seasonal temperature (summer and winter) changes to be precisely controlled. In addition, the use of large-scale mesocosms will eliminate variability in a number of other environmental parameters such as pH, dissolved oxygen (DO), and salinity.

3.2.1 Experimental design and statistical analyses

In February 2012 and August 2012, 180 cultured triploid oysters (>100 mm) were obtained from the Louisiana Sea Grant Oyster Research and Demonstration Farm off Grand Isle, LA. Salinity recorded close to the farm by a U.S.G.S. continuous data recorder (# 073802516) averaged 21.2 ± 0.1 (mean ± SE, range: 5.0-33.6) between 2002 and 2013. The oysters were the progeny of oysters spawned in summer 2010. Approximately 220 diploid oysters (>75mm) were collected from a commercial lease located at Caillou Lake, Louisiana. Salinity recorded at the Caillou Lake (Sister Lake) site by a U.S.G.S. continuous data recorder (# 07381349) averaged 19.9 ± 0.3 (mean ± SE, range: 6.3-22.7) between 2002 and 2013. The diploid and triploid oysters were randomly assigned to five (5) dual recirculating tank systems (500 ppm, 5,000 ppm, 25,000 ppm, sediment only, and water only). Each treatment system consisted of two (2) 200-L tanks each filled with 175 L of aerated artificial seawater (ASW, Crystal Sea Marinemix, Aquatic Ecosystems, FL, USA) adjusted to 22 ‰ ± 2 ‰ (Figure 3.1). An additional dual tank depuration system containing aerated ASW was used to hold the oysters during the designated depuration period. For each treatment system, the ASW

was recirculated through a 0.5 ft^3 biological bead (Anoxkaldnes, Sweden) filtration device at a rate of 10 gallons per minute (gpm). Water temperature was maintained at 19°C ± 1° for the winter study and 26°C ± 1° for the summer study. The tanks were equipped with slotted polypropylene holding trays to allow stacking of the oysters and provide circulation of water between oysters. Approximately 35 triploid and 40 diploid oysters (75 adult oysters/m^2) were allotted to each treatment system and allowed to acclimate to the water for one (1) week. The study's population density is comparable to densities found in natural oyster reefs (60-150 adult oysters/m^2). Oysters were fed daily with 0.3 mL Pavlova 1800 (Reed Mariculture Inc., Campbell, CA, USA) per oyster. The oil-contaminated sediments used for dosing treatment systems were prepared by adding 175 mg, 1.75 g, and 8.75 g of British Petroleum (BP) South Louisiana crude (SLC) surrogate oil (Figure 1) to 350 g of wet sediment (50% moisture) into a 1-gallon glass mixing container. The surrogate oil was collected from the Marlin Platform of the Dorado field, located 23 miles NE of the Macondo spill site, and possesses physical properties and chemical characterization similar to the Mississippi Canyon lease block 252[85]. The BP SLC surrogate oil used in these studies is currently being distributed by BP as a surrogate research oil for the oil spilled during the DWH incident. Gas chromatography/mass spectrometry (GC/MS) analysis showed the BP SLC surrogate oil contained a total PAH (tPAH) concentration of 5,470 mg/Kg. The individual PAHs used to determine tPAH concentrations during the studies are shown in Figure 3.2. The sediment only container received 350 g of wet sediment. The sediment sample was collected near the Louisiana Sea Grant and Research and Demonstration Farm in

Figure 3.1 Dual recirculating tank system used in oyster exposure study.

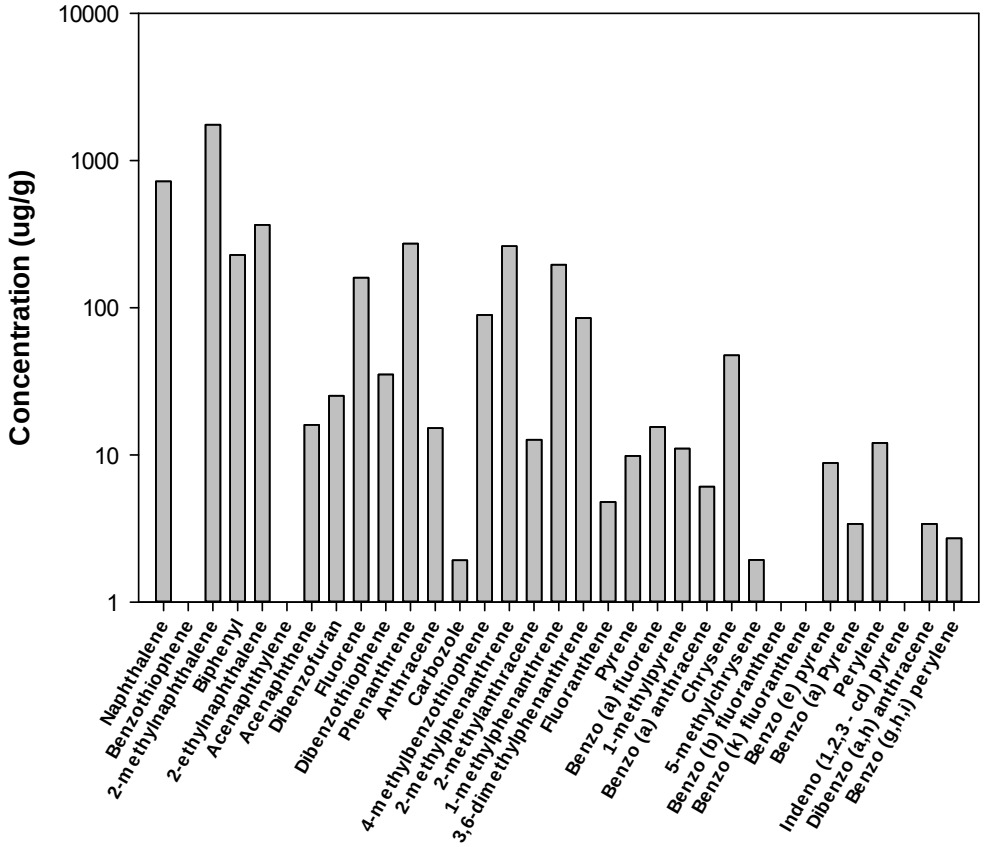

Figure 3.2 Individual PAH concentrations in MC252 surrogate oil.

Grand Isle, Louisiana. Approximately 2-L of ASW was added to each mixing container and placed on an orbital shaker for 48 hours. After mixing on the shaker, a small sediment sample from the 500 ppm, 5,000 ppm, 25,000 ppm, and sediment only mixing containers were analyzed and average tPAH concentrations were determined to be 2.58 mg/Kg, 25.3 mg/Kg, 119 mg/Kg, and 0.335 mg/Kg (wet wt.), respectively. Prior to dosing with spiked sediments, five diploid and five triploid oysters were collected from each treatment system to determine baseline PAH concentrations within the oysters. Immediately after baseline sampling, designated treatment systems were dosed with two (2) liters of the 500 ppm, 5000 ppm and 25,000 ppm oil-contaminated sediments

(wet weight basis) and unoiled sediment (sediment control) for a final sediment suspension load of 500 mg (dry weight) per liter. Water in the tanks was mixed daily to re-suspend sediments settled overnight. At the end of week one (1), four diploid and four triploid oysters were collected from each treatment system for PAH and condition index (CI) determination. Whole oysters were carefully rinsed with deionized (DI) water, opened, and meat removed and weighed (g) prior to storage in a -70 °C freezer for future PAH analysis. Following week one sampling, the designated treatment systems were spiked with a second dose of a two (2) liter volume of 500 ppm, 5000 ppm and 25,000 ppm oil-contaminated sediments (wet weight basis) and unoiled sediment (sediment control) for an estimated total sediment suspension load of 1000 mg (dry weight) per liter for each treatment system. At the end of weeks two and three oyster (4 diploid and 4 triploid) were collected from the five treatment systems and processed as described for week one sampling. Following week three sampling, a total of 115 oysters (59 diploid and 57 triploid) were collected from the three (3) oil-sediment treatment systems and gently rinsed with ASW to remove any sediment residual from the shell. The oil-contaminated diploid and triploid oysters were transferred to designated holding trays and placed in the depuration tank system. A total of 43 oysters (23 diploid and 20 triploid) from the sediment control treatment system were transferred into designated holding trays and placed into the water control treatment system. The oysters were later sampled (4 per ploidy) on a weekly basis from week four to the end of the 7-week study. Oyster mortality was checked daily and cumulative weekly mortality was calculated correcting for sampling according to Ragone Calvo et al.[86]. Five diploid and five triploid oysters were collected at the end of each study for total lipid and glycogen

determination. Methods to determine CI, total lipid, glycogen, and PAH concentrations in oysters are described below.

Cumulative mortality of oysters exposed to oil-contaminated sediment, sediment control, and water control were compared with a Chi-squared analysis at one, three, and seven weeks. Oyster responses to oil and total PAHs concentration were analyzed with two-way analysis of variance (ANOVA) using SPSS statistical software. In this design the first factor was ploidy and had two levels, diploid and triploid. The second factor within the design was sediment treatment concentration and had three levels: 500 ppm, 5000 ppm, and 25,000 ppm. Physiological determinations (i.e. CI, lipid, and glycogen) were analyzed with a one-way ANOVA. Least-square means with a Tukey adjustment were used following significant ANOVA results ($P<0.05$) to examine the differences among treatments. Prior to statistical analysis data was tested for significant outliers, normality, and homogeneity of variance. All data are presented as mean ± standard deviation.

3.2.2 Sample Preparation

The oyster tissue samples were extracted using a modified QuEChERS extraction procedure[87]. For the modified QuEChERS extraction procedure, the following stepwise procedure was followed: (1) weigh 15.0 g ± 0.1 g of homogenized oyster tissue sample into a clean 50 ml Teflon centrifuge tube; (2) fortify tissue with a 100 µl of 3.0 µg/ml working surrogate solution directly onto the oyster tissue matrix (20 ng/g) and vortex for 2 minutes (min) @ 2,000 revolutions per minutes (rpm); (3) protect from UV light and let stand for 30 minutes; (4) add 15 ml of extraction solvent (30%

acetone, 30% MEK, and 40% CH) and vortex for 2 min @ 2,000 rpm; (5) add the contents of a Restek Q-sep QuEChERS AOAC 2007.01 extraction salts packet to 50-ml centrifuge tube, immediately shake for 1 min, then sonicate for approximately 4 minutes; (6) centrifuge the tube at 5,000 rpm for 5 min; (7) transfer 6.4 ml of the solvent extract to a Restek Q-sep Q351 dSPE 15-ml cleanup tube and vortex for 30 seconds; (8) centrifuge for 1 min at 6,000 rpm; (9) transfer 1 ml of the solvent extract to a 2-ml amber autosampler vial, add 5.0 µl of 2000 µg/ml internal standard solution, cap and store in 4°C refrigerator until analysis. One method blank was prepared per extraction batch (20 samples) by using 15 g of deionized water in place of the tissue matrix. PAH concentrations found in the method blanks were averaged and subtracted from sample results. Multiple validation studies have been performed using similar procedures for the determination of PAHs in edible seafood[38,39].

3.2.3 GC-MS Analyses

All calibration standards and samples were analyzed using an Agilent GC-MS system equipped with a 7890A GC and 5975C MS detector (Santa Clara, CA) operating in positive ion mode with electron impact ionization (70 eV). Mass spectral data was acquired utilizing selective ion monitoring (SIM) mode and DB-5MS capillary column (30 m length, 0.25 µm film thickness, 0.25 mm i.d., Agilent J&W). The injection port was operated in the pulsed splitless mode, fitted with a 2 mm glass liner with deactivated glass wool, and delivered a 1-2 µl injection via an Agilent 7683B Series autosampler to an inlet maintained at 280 °C. The chromatographic conditions were the following: He carrier gas constant flow 1.0 ml/min, the initial oven temperature was 70 °C, 2 min hold,

ramp to 280 °C at 6 °C/min, 3 min hold, and ramp to 300 °C at 3 °C/min for a final run time of 46.67 min. Mass spectrometer transfer line, source, and quadruple temperature were 280 °C, 230 °C, and 150 °C, respectively. PAH SIM quantitation and confirmation ion are shown in Table 2.1 along with retention times and percent relative standard deviation (% RSD). The method detection limits for the individual PAHs ranged from 0.5 to 2.0 ng/g (ppb).

3.2.4 Quality Control

All biota and sediment samples were collected in triplicate or greater and all measurements were run in in triplicate for standards and samples. PAH concentrations were calculated and expressed in µg/Kg dry weight. The analytical blanks were processed in the same manner as the samples and concentrations were determined using standard solutions. The surrogate recoveries for PAHs during these experiments were found to be between 82-103%; no samples were outside these limits.

3.2.5 Statistical Analysis

Results of PAH concentrations, biochemical parameters, and water quality parameters were analyzed using SPSS 22.0 (SPSS INC., Chicago, IL) software. T-test, one-way and two-way ANOVA were used to examine differences between spatial, temporal, and ploidy observations and PAH concentrations. A significance level of 95% was used.

3.2.6 Condition Index

Oysters were cleaned of any attached organisms. After drying the shells with blotting paper, the whole weight was measured on an analytical balance before opening the shells. Whole meat was removed, dried at 60°C for 48 h and then weighed to the nearest 0.01 g. The shell was also recorded. The condition index (CI) of the oyster was determined according to the following formula[88]:

$$\mathrm{CI} = \frac{\text{Drying Weight} \times 100}{\text{Total Weight} - \text{Shell Weight}}$$

3.2.7 Glycogen Content

The glycogen content was determined with the method described by Li[89]. The gill, mantle and adductor tissues were removed separately and frozen in a -70°C freezer. Before analysis, these tissues were ground into a fine powder using mortar and pestle. Each replicate sample consisted of three pooled animals. The results of glycogen measurements were expressed in mg per gram of tissue weight. Briefly, freeze –dried oyster samples were suspended in a 60 ml volume of 30% KOH solution, and saponified by heating to 100°C for approximately 30 minutes. After cooling, an aliquot of the saponified solution was treated with the cold 0.2% anthrone-sulfuric acid solution for 10 min, and then the absorbance of the resulting colored complex was measured at the wavelength of 620 nm.

3.2.8 Total Lipid Content

The total lipid content was determined using the Smeded method[90]. A 5.0±0.5 g portion of oyster tissue was homogenized in a Waring blender and weighed into a 50-ml centrifuge tube. Approximately 8 ml of isopropanol and 10 ml of cyclohexane was then added to centrifuge tube and sample homogenized. Approximately 7 ml of deionized water was added and the sample was homogenized again. A centrifuge was used to separate the organic extract from the particulate material. The organic extract was removed and placed in a pre-weighed flat-bottomed flask. A second extraction was carried out using 25 ml of a 13% (v/v) isopropanol in cyclohexane solution. Again, a centrifuge was used to separate solvent and particulate material. The organic solvent from second extraction was combined with the first extract in the flask. The sample was dried with a rotovap apparatus and the flask was placed in an oven (80°C ± 5°C) for 1 hour. The residual was weighed and the lipid content calculated.

3.3 Results and Discussion

3.3.1 Cumulative Mortality and Condition Index

No significant difference in oyster mortality could be found between oil treatments after one, three, and seven weeks. There was a statistically significant difference in CI between ploidy (diploid and triploid) as determined by one-way ANOVA (F (3, 16) = 53.439, $p < 0.0005$). A Tukey post-hoc test revealed that the condition index was significantly lower for the summer diploids (6.96 ± 0.7) when compared to the summer triploids (10.0 ± 0.5, $p < 0.0005$), winter diploids (10.4 ± 0.53, $p = < 0.0005$), and winter

triploids (11.3 ± 0.55, p < 0.0005). There were no statistically significant CI differences between the winter diploids and the winter triploids (p = 0.092) and summer triploids (p = 0.814). Results for the condition index determinations are shown in Figure 3.3.

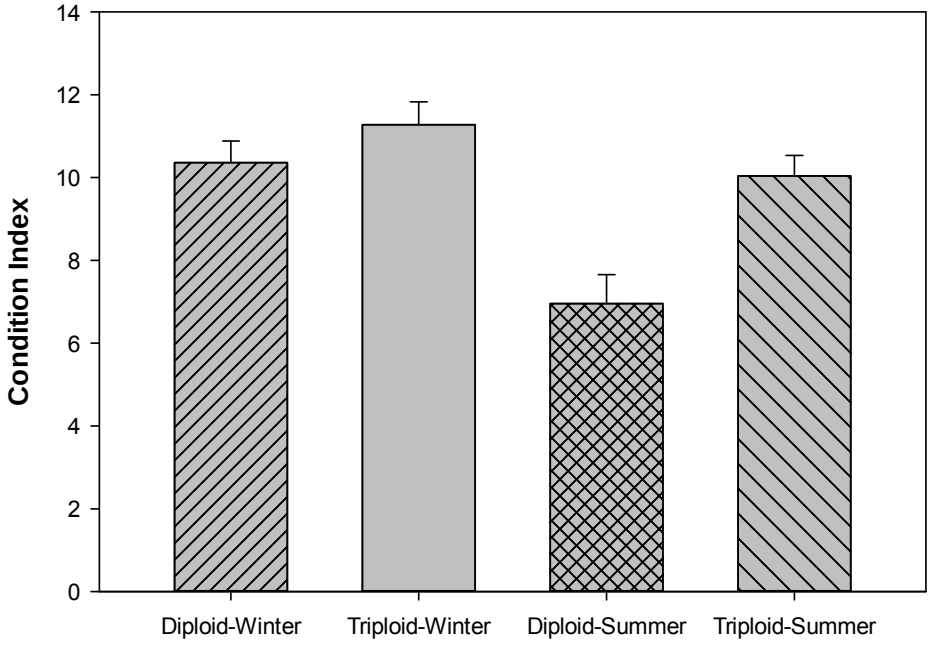

Figure 3.3 Condition index for diploid and triploid oysters at end of studies.

3.3.2 Total Lipid Content

There was a statistically significant difference in total lipid content between ploidy as determined by one-way ANOVA (F (3, 16) = 32.936, p < 0.0005). A Tukey post-hoc test revealed that the % total lipid content was significantly higher for the summer diploids (14.9 ± 0.86) when compared to the summer triploids (10.6 ± 0.58, p < 0.0005), winter diploids (9.6 ± 0.92), and winter triploids (10.6 ± 1.23, p < 0.0005). There were no significant differences between the winter triploids and the summer triploids

(p = 1.000) and winter diploids (p = 0.337). Also, there were no significant differences between the winter diploids and the summer triploids (p = 0.337). Results for the total lipid content determinations are shown in Figure 3.4.

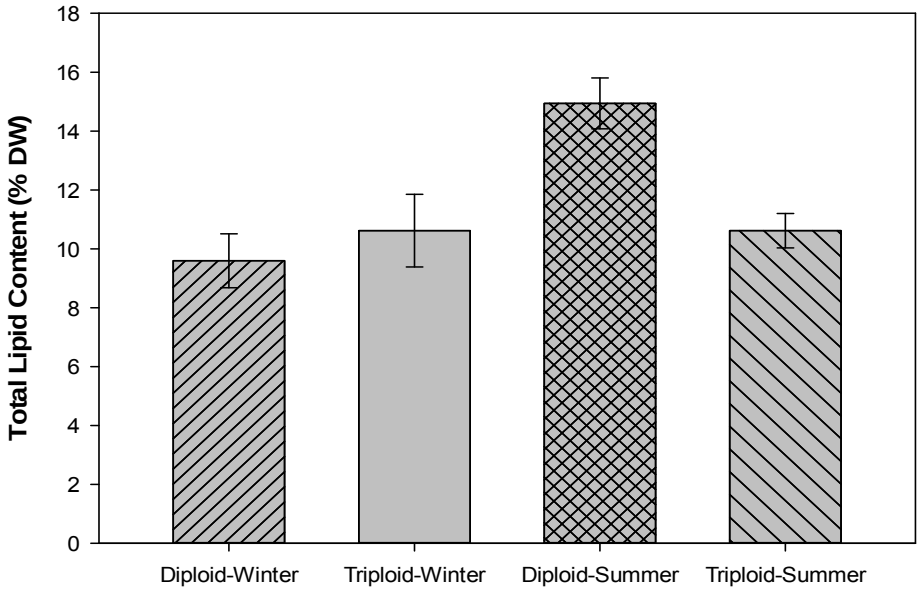

Figure 3.4 Total lipid content for diploid and triploid oysters at end of studies.

3.3.3 Glycogen Content

There was a statistically significant difference in glycogen content between ploidy as determined by one-way ANOVA (F (3, 16) = 349.284, p < 0.0005). A Tukey post-hoc test revealed that the % glycogen content was significantly lower for the summer diploids (3.91 ± 0.81) when compared to the summer triploids (24.3 ± 1.62, p < 0.0005), winter diploids (27.7 ± 1.87, p = < 0.0005), and winter triploids (28.5 ± 1.10, p < 0.0005). Additionally, the statistical analysis showed that the glycogen content was significantly lower for the summer triploids when compared to the winter triploids (p <0.001) and

winter diploids ($p < 0.007$). There were no statistically significant glycogen differences between the winter diploids and the winter triploids ($p = 0.649$). Results for the glycogen content determinations are shown in Figure 3.5.

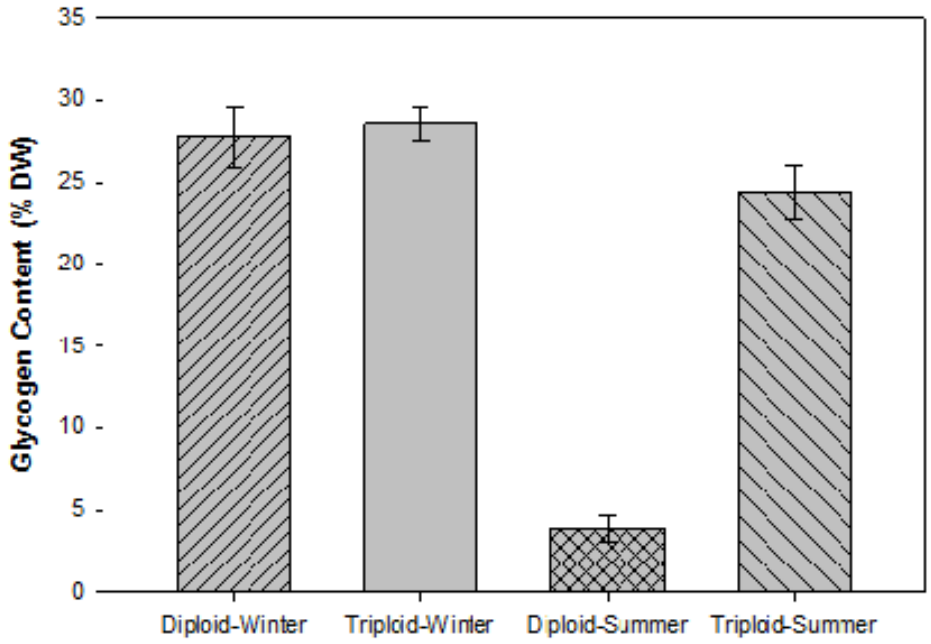

Figure 3.5 Glycogen content of diploid and triploid oysters at end of studies.

3.3.4 PAH Concentration in Oysters

A two-way ANOVA of the diploid and triploid oyster results from the summer study indicated there were statistically significant between the effects of ploidy and treatment levels on the PAH concentration ($p< 0.0005$). The summer diploid oysters had maximum average total PAH concentrations of 403, 1380, and 1956 ng/g for the 500, 5000, and 25000 ppm sediment treatments, respectively. The summer triploid oysters had maximum average total PAH concentrations of 564, 2005, and 2912 ng/g for the 500, 5000, and 25,000 ppm sediment treatments, respectively. The winter

diploid oysters had maximum average total PAH concentrations of 531, 1812, and 2781 ng/g for the 500, 5000, and 25000 ppm sediment treatments, respectively. The winter triploid oysters had maximum average total PAH concentrations of 598, 2099, and 3094 ng/g for the 500, 5000, and 25000 ppm sediment treatments, respectively. Results show there was a significant increase of 40.0%, 45.3%, and 48.9% in total PAH content between the summer diploid and triploid oysters with the 500, 5000, and 25000 ppm exposure treatments, respectively. There was a 31.3%-58.2% increase in total PAH content between the summer diploid oysters and remaining seasonal treatments (winter diploid and triploid) over the exposed oil treatment range (500, 5000, and 25000 ppm). A comparison of the summer and winter triploids showed there was no significant interaction between the effects of ploidy and treatment levels on the PAH concentration in triploid oysters ($p=0.814$). A statistical analysis of the winter diploid and triploid study indicated there was no significant interaction between the effects of ploidy and treatment levels on the PAH concentration in triploid oysters ($p=0.742$). A comparison of the winter and summer diploid oyster concentrations showed there was a statistically significant interaction between the effects of ploidy and treatment levels on PAH concentrations in diploid oysters ($p= 0.001$). The tPAH burden in the diploid and triploid oysters reached their maximum levels approximately two weeks after exposure and decreased exponentially till the end of the 7-week studies. During the summer study the average tPAH half-life for diploid and triploid oysters were 4.7 and 4.4 weeks, respectively. The average tPAH half-life for both the diploid and triploid oysters during the winter study was 4.2 weeks. Statistical analysis of the tPAH half-lives of the diploid and triploid oysters indicated there was no significance difference between the summer

and winter seasons. Results for the PAH determinations are shown in Figures 3.6 and 3.7. Beginning of depuration period is indicated by a vertical dashed line. It should be noted that water and sediment control lines overlap on graphs.

The results of the mesocosm studies have shown uptake and bioaccumulation of petroleum-based PAHs into all treatment tank systems. It can be seen that uptake and bioaccumulation of PAHs can be a complex process that is more than simply dietary ingestion of contaminated sediment. The bioaccumulation and depuration of hydrophobic contaminants by marine bivalves can vary significantly depending on a wide range of variables including seasonal effect (temporal changes in both physiological response and feeding patterns), behavioral patterns, sexual condition, water temperature, and length of contaminant exposure[91].

This study provides useful information on the relationship between oyster ploidy and the seasonal uptake and depuration rates of the Eastern oysters exposed to SLC oil under laboratory conditions. The relationship between seasonal temperature variations and oyster ploidy suggest that triploid oysters may be a more suitable bioindicator of PAH contamination during the natural oyster spawning season, typically between the months of May through August. Lack of reliability in diploid oysters is due to the physiological changes encountered during spawning season and change in nutrient/feeding patterns associated with the summer months. Seasonal trends in PAH concentrations have been well documented during in-situ studies[92,93,94] and are clearly seen in this mesocosm study. The significant increase in lipid and decrease in glycogen content[95] within the diploid oysters during the summer study clearly indicates that the oysters were in the process or had recently undergone spawning. Following the initial

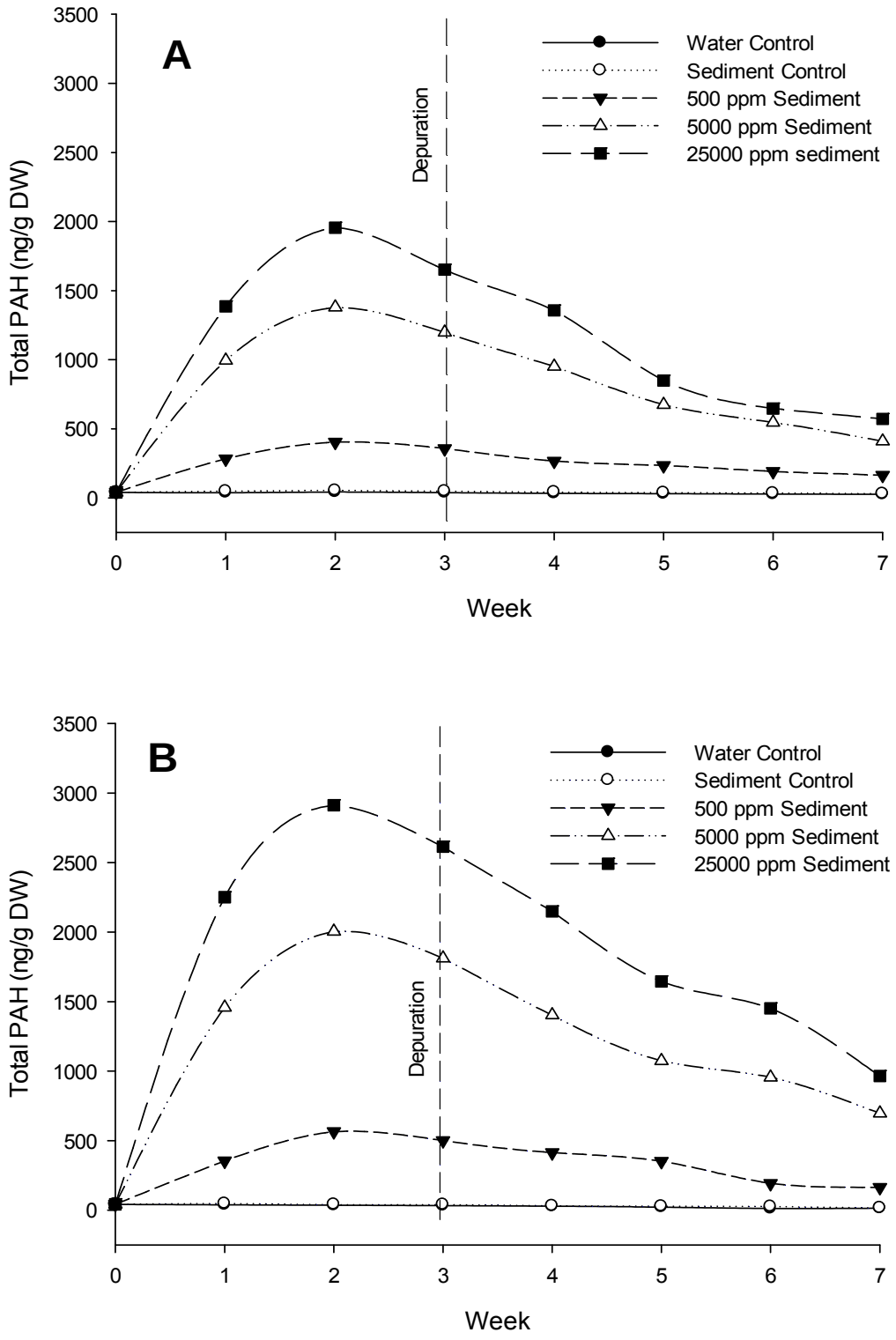

Figure 3.6 Total PAH concentrations in (A) diploid and (B) triploid oysters for individual treatments during summer study.

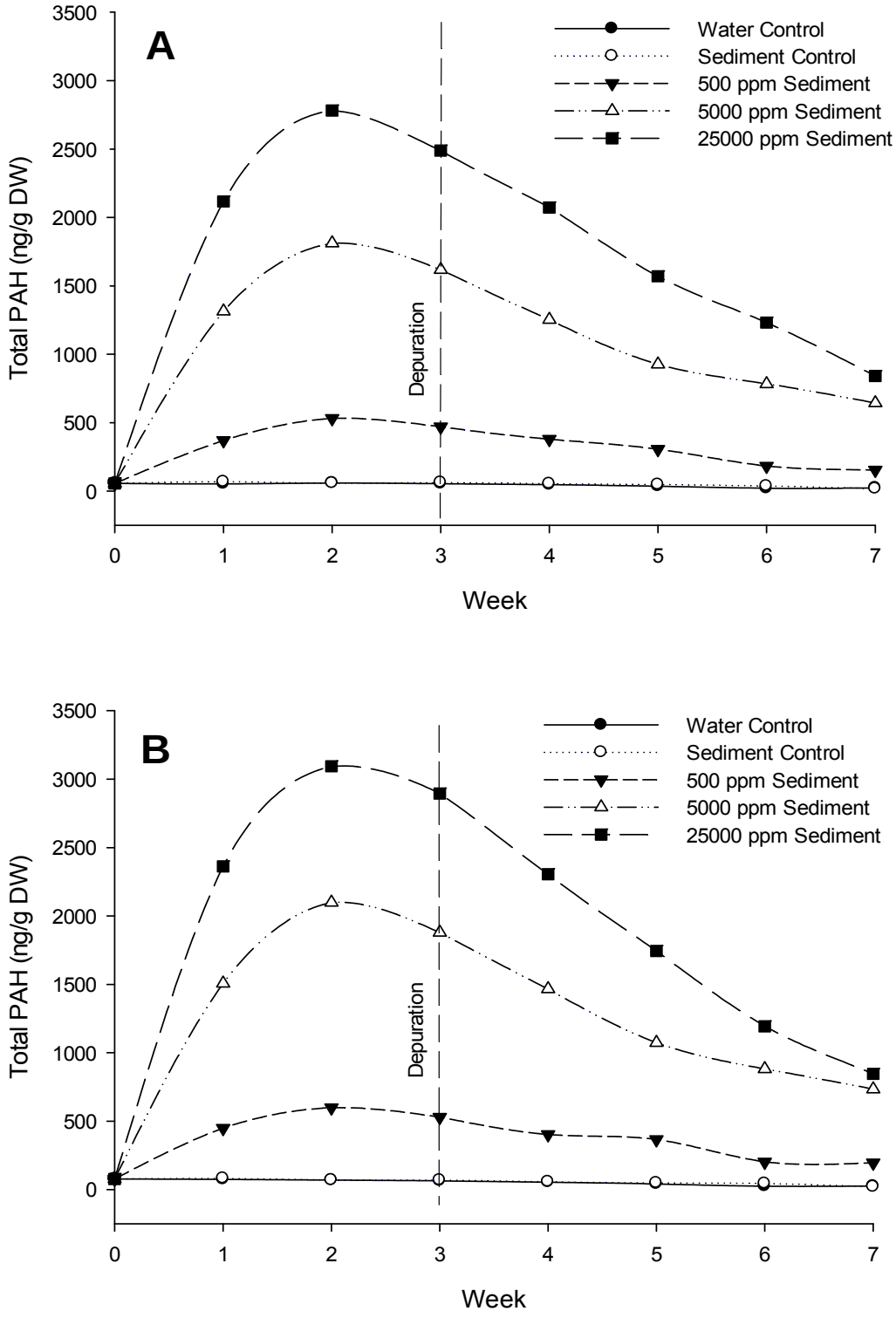

Figure 3.7 Total PAH concentrations in (A) diploid and (B) triploid oysters for individual treatments during winter study.

spawning, diploid oysters may undergo a secondary spawning. The elevated lipid levels in the summer diploid oysters most likely associated with this secondary spawning. As a consequence of biochemical replacement during reproduction, the lipid content of diploid oysters varied from 7.8 to 9.2 % of total tissue dry weight during the spawning season. The results from the study indicated there was no seasonal variation in the total PAH a concentration within the triploid oysters. The total PAH concentrations within the winter diploid oysters were not significantly different ($p = 0.138$) than the concentrations recorded for both the summer and winter triploid oysters. Many studies have shown how caged diploid bivalves can be used to demonstrate short-term contaminant trends, temporal and spatial variability, and dose-response relationships [30,96,97]. However, this study has demonstrated the usefulness and versatility of caged triploid oysters as an effective tool for assessing exposure and effects in a variety of marine environments. A summary of the tabulated PAH results for the seasonal oil exposure studies (Tables A.7 & A.10) are located in the appendix.

3.4 Conclusions

The bioaccumulation of oil-related PAHs was characterized in diploid and triploid Eastern oyster (*Crassostrea virginica*) in a laboratory mesocosm study and their response to seasonal temperature variations was determined. The bioaccumulation and depuration of PAHs is similar for all triploid oysters (winter and summer) and winter diploid oysters. However, PAH concentrations within the summer diploids were significantly lower in comparison to the triploid and winter diploid oysters. The decrease in PAH concentrations can be attributed to physiological and behavioral changes induced by the spawning process. The results support the research hypothesis, indicating that triploid Eastern

oysters are more effective than diploid Eastern oysters for biomonitoring PAH uptake in the summer months during short-term laboratory exposure studies. This study has clearly shown the triploid Eastern oyster to be a suitable bioindicator organism for short-term monitoring of oil and chemical spills within the marine environment.

CHAPTER 4. POLYCYCLIC AROMATIC HYDROCARBONS IN SEDIMENT AND CAGED EASTERN OYSTERS (CRASSOSTREA VIRGINICA) FROM THE BARATARIA BAY REGION: USE OF TRIPLOID OYSTERS AS A TOOL TO ASSESS OIL SPILL IMPACTS

4.1 Introduction

Polycyclic aromatic hydrocarbons (PAHs) are widespread chemical pollutants that are introduced into the aquatic environment from a number of sources. They can originate as a product of pyrolysis, distributed by biogenic sources, or released to the environment as a result of oil spills or natural seeps (petrogenic). The *Deepwater Horizon* oil spill began on 20 April 2010 in the Gulf of Mexico on the BP-operated Macondo Prospect. It claimed eleven lives and is considered the largest accidental marine oil spill in the history of the petroleum industry. Following the explosion and sinking of the *Deepwater Horizon* oil rig, a sea-floor oil gusher flowed for 87 days, until it was capped on 15 July 2010. The U.S. Government estimated the total discharge at 4.9 million barrels (210 million U.S. gal; 780,000 m^3)[98]. In July, tar balls reached Grand Isle and the shores of Lake Pontchartrain. In September a new wave of oil suddenly coated 16 miles (26 km) of Louisiana coastline and marshes west of the Mississippi River in Plaquemines Parish[125]. As of July 2011, about 491 miles (790 km) of coastline in Louisiana, Mississippi, Alabama and Florida were contaminated by oil and a total of 1,074 miles (1,728 km) had been oiled since the spill began. As of December 2012, 339 miles (546 km) of coastline remain subject to evaluation and/or cleanup operations[99]. The Bay Jimmy area was reported as having received a significant amount of oil from the BP oil spill – over 32,000 gallons of oil were removed during a 10-day period of cleaning[125].

The analysis of PAH concentrations in sediments can give information on overall contamination levels, but is unable to predict the PAH fraction that is available to the surrounding biota. The dissolved fraction of spilled petroleum (i.e. low molecular weight PAHs) is readily available to filter-feeding bivalves, but because of their low water solubility and volatility[100] determination of their concentrations in water is sometimes difficult. The bioavailability of sediment-associated hydrocarbons on multiple chemical physio-chemical properties, sediment characteristics, and characteristics of the indigenous biota[101]. The primary characteristic governing sediment associated compound bioaccumulation is the hydrophobic characteristic of the organic compound. The lowest molecular weight and higher water soluble chemical compounds are the most bioavailable, entering the biotic system through respiration and direct exposure[102]. Sediment total organic content, grain-size distribution, interstitial water, sediment weathering, and petrogenic/pyrogenic origin are just a few of the environmental parameters influencing contaminant bioavailability in the environment[103,104]. In addition, elevated water turbidity, location of organism in the water column, and mode of feeding have been shown to influence exposure of organisms to pollutants in aquatic ecosystems[105,106]. Satellite imagery studies have shown there is a strong correlation between elevated turbidity levels in estuaries and large-scale meteorological events (i.e. tropical storms and hurricanes)[107,108].

Oysters are filter-feeding bivalves and as such are exposed to chemical pollutants that are either water soluble or adsorbed on sediment or suspended particles. The two major routes of pollution uptake are direct uptake of the water-solubilized PAH fraction (e.g. benzene, toluene, ethyl benzene, and xylenes) via the gills, and indirect

absorption of the fine grain-size fraction of the sediment or suspended particles (i.e. suspended solids) and the assimilation of PAHs through the digestive tract[109]. Bivalves are widely used as indicators to assess the bioavailability of contaminants because of their ability to accumulate organic and inorganic contaminants in their tissues at concentrations many times higher than those in the surrounding environment. For this reason, contaminant concentrations in bivalve tissues more accurately reflect the magnitude of environmental contamination[110]. Environmental contaminant concentrations and accumulation in bivalves are influenced by many bio-physiological factors, including sampling season, condition index, sex, changes in tissue composition, and reproductive cycle of the selected organism[111]. Seasonal variations in metal concentrations have been related to seasonal changes in tissue mass during the development of gonadal organs (i.e. spawning)[112]. Triploid (3n) oysters have three sets of chromosomes rather than two sets like a wild organism, which are diploid (2n). Triploid organisms are sterile, which means they do not put energy into reproduction. The energy not used for reproduction results in faster growth rates, while maintaining stable biochemical composition (e.g. lipid, glycogen, and protein) throughout the year.

Contamination monitoring programs, such as the U.S. Mussel Watch and European Oslo and Paris Commissions (OSPAR), were developed to estimate the degree of pollution of selected areas and the processes controlling the inputs, fates, and biological effects of these environmental contaminants[113]. Bivalves concentrate many organic pollutants, making trace-level contaminants easily detected in their tissues using modern analytical techniques. However, such monitoring programs can only be utilized if bivalves are present in the areas to be studied. If not, caging technology,

where bivalves are placed in cages positioned in selected locations, has to be used. Monitoring pollutant contamination with caged organisms is an evolving technology in the U.S. and European nations[114,115,116].

The present study is focused on sediment and caged oysters (diploid and triploid) located in the northern Barataria Bay, Louisiana region. Although numerous studies have published and documented PAH levels in sediments and bivalves (indigenous and caged) following oil spill events[10,15,20], to my knowledge, the present study is the first to detail PAH bioaccumulation and temporal variations using diploid and triploid oysters in the experimental design. Caged diploid and triploid oysters were placed in various sites near Bay Jimmy and Grand Isle, Louisiana. Oysters and sediment were sampled (7 sampling events) over a 15-month period and analyzed for PAH content. In addition, numerous water and field parameters were measured during the sampling events. Sediments were sampled to quantify PAHs and to estimate contamination levels in the different sites as well as to confirm the origins of the contamination. Bivalve samples were analyzed to determine PAH content in tissues and determine bioaccumulation factors for total PAHs (oyster PAH concentration divided by the sediment PAH concentration). The main objectives of this study are to investigate PAH contamination in Eastern oysters (diploid and triploid) throughout an entire reproductive cycle and determine sediment and bivalve contamination levels at multiple sites within the Barataria Bay estuary system. The investigator will attempt to determine if there is a difference in PAH uptake and depuration in oysters (diploid vs. triploid) with variations in seasonal (winter and summer) conditions.

4.2 Material and methods

4.2.1 Study Site

Located in the southeast quadrant of Louisiana, directly south of the city of New Orleans, Barataria Bay (Figure 4.1) is an asymmetrically shaped shallow estuary with a horizontal dimension of approximately 50 x 50 km. It is bound on the east by the Mississippi River and the old Mississippi River ridge on the west. The bay has multiple tidal inlets connecting with the coastal waters of Louisiana Bight. Barataria Pass is one of the freshwater outlets from Barataria Bay, located between the Grand Isle and Grand Terre Island with a width of approximately 600 m. The predominant source of freshwater into the basin is Mississippi River water through the man-made Davis Pond Diversion facility, which has a maximum capacity of about 250 m^3/s. Overall, the bay has an average depth of 2 m. The main entrance to Barataria Bay (Barataria Pass) has an average depth of slightly greater than 20 m. Tide in the Barataria region is microtidal with a maximum tidal range of approximately 0.6 m.

The *Deepwater Horizon* oil spill resulted in heavy oiling conditions in the salt marshes of Northern Barataria Bay, including portions of Bay Jimmy, Bay Batiste, Wilkinson Bay, St. Mary's Point, and vicinity. Due to the degree and nature of oiling in these areas, traditional marsh treatment methods, including natural attenuation, did not appear to be effective for the most heavily oiled shorelines. In addition, there was concern that long-term oiled marsh recovery could be at risk without some form of intervention. There was also the competing concern that cleanup in the marshes could cause further damage, delaying or limiting oiled marsh recovery, as has often been observed following previous oil spills. Due to these multiple factors, a series of marsh

treatment field tests was conducted followed by periodic monitoring, leading to an operational-scale Shoreline Treatment Recommendation (STR). The STR was scheduled to be completed over a seven-month period, but federal authorities determined it would be beneficial for the site to remain undisturbed and allow researchers to study the oiled site over time[117].

Oyster cages (Chesapeake Bay Oyster Company, Wake, VA) were constructed of heavy gauge wire coated with high density polypropylene to prevent salt water erosion (Figure 4.2). Individual cages were approximately 80 cm long, 80 cm wide, and 15 cm deep. Diploid *Crassostrea virginica* were purchased from a wholesale oyster distributor located in Houma, Louisiana and harvested from an oyster lease located within Caillou "Sister" Lake. Triploid *Crassostrea virginica* were donated by Dr. John Supan and collected from the Sea Grant Oyster Hatchery, located in Grand Isle, Louisiana. Approximately 35 diploid and 35 triploid oysters were allocated to each cage and one cage was then placed in each of the six sites in June 2011. The weighted cages were elevated approximately 3-4" off the soft sediment with wooden braces and secured to a 2" support pipe via a stainless steel chain. Sediment and biota samples were collected at five sites in the Bay Jimmy (BJ) area and one site near the Sea Grant Oyster Hatchery on Grand Isle (GI). Additional sites were established in Bay Batiste and Sansbois but were either vandalized or lost to excessive sediment load (TS Lee) prior to the second sampling event.

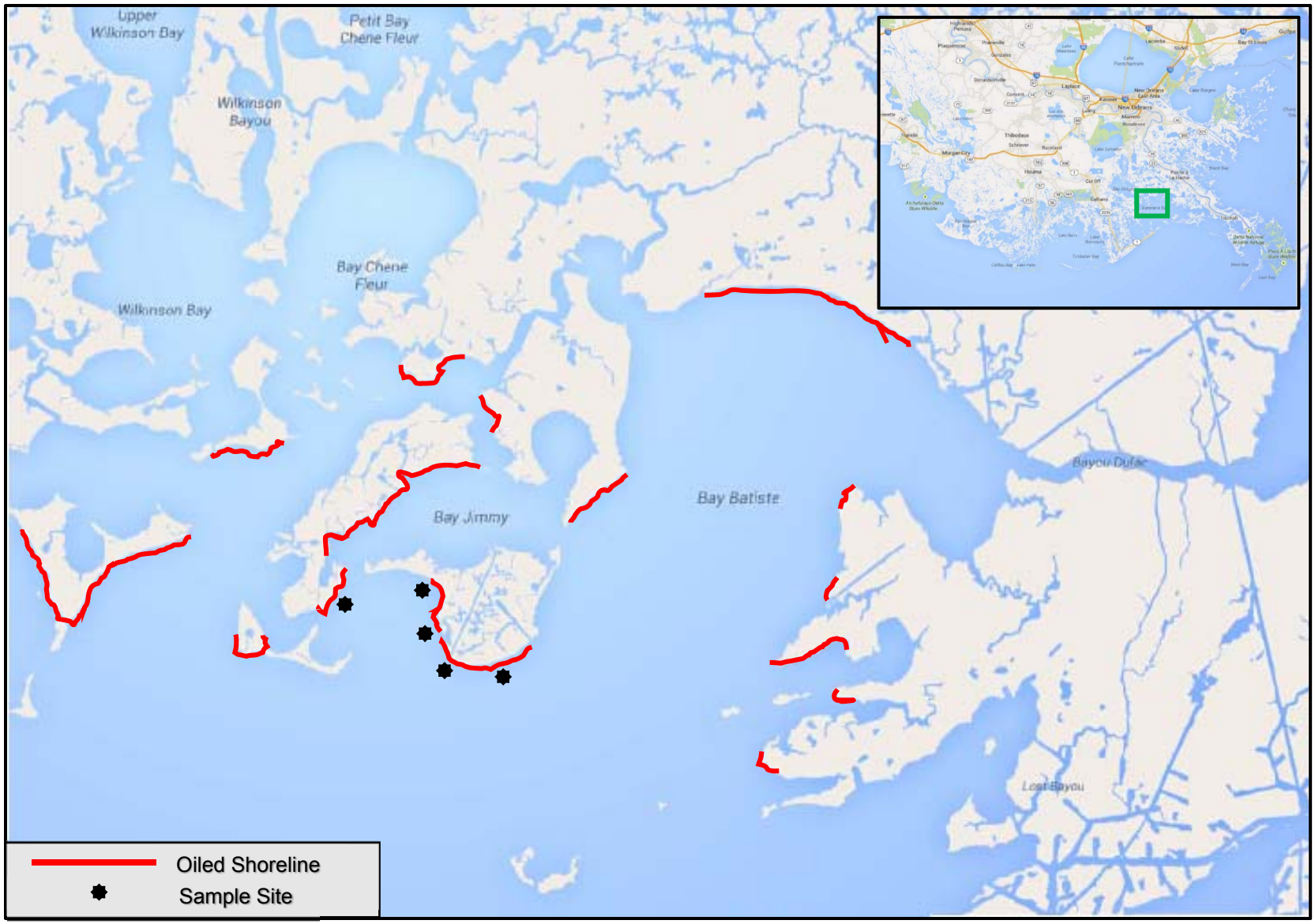

Figure 4.1 Location of Bay Jimmy sites within northern Barataria Bay Estuary.

4.2.2 Sample collection

Samples were collected on 07 July 2011, 16 September 2011, 21 November 2011, 28 February 2012, 30 May 2012, 23 August 2012, and 07 September 2012. To simplify identification, sample collection dates are identified by month and year within this document. Site sediment characteristics and coordinates are shown in Table 4.1. Triplicate sediment samples were collected from the individual sites with a hand auger during each sampling event. Approximately 30 diploid and 30 triploid oysters were collected from the individual sites during each sampling event. In addition to sediment and biota, the investigator collected water and field measurements at the Bay Jimmy (sites 1-5) and Grand Isle (site 6) locations. Sampling was performed on the same day at all six sites to avoid possible variations in PAH content due to weather conditions. Sediment samples were placed in 125-ml amber glass jars and transferred in an ice chest to the laboratory. Sediment samples were frozen at 0°C after arriving at the laboratory. Biota samples were collected in triplicate and hand rinsed with clean seawater at the point of collection. The samples where then placed in individual clean plastic bags and transferred in an ice chest to the laboratory. Once at the laboratory, oyster tissue and shell were separated and rinsed with deionized water and dried with a clean paper towel. Tissue and shell weight were measured and recorded. Tissue samples were placed in clean plastic bags and frozen at -70°C until sample preparation.

4.2.3 Chemicals

A stock solution of 33 parent PAHs and substituted PAHs (2000 µg/ml) was prepared by combining a 17 EPA priority pollutant PAH mix, two (2) custom PAH

Figure 4.2 Oyster cages used during the field study[118].

Table 4.1 Coordinates and sediment characteristics for Bay Jimmy and Grand Isle sites.

Site ID	Name	Coordinates		Sediment Name	Textural Group
		Latitude	Longitude		
1	Bay Jimmy	29°26'29.16" N	89°54'09.55" W	Medium silt	Silt
2	Bay Jimmy	29°26'36.93" N	89°53'14.08" W	Medium silt	Silt
3	Bay Jimmy	29°26'27.98" N	89°54'09.22" W	Coarse silt	Silt
4	Bay Jimmy	29°26'08.85" N	89°54'01.60" W	Coarse silt	Silt
5	Bay Jimmy	29°26'04.87" N	89°52'49.74" W	Coarse silt	Silt
6	Grand Isle	29°14'19.67" N	90°00'10.13" W	Coarse silty fine sand	Silty sand

mixes, and multiple individual PAH standards to volume with 50% Acetone/50% Dichloromethane. The instrument calibration standards were purchased from Absolute Standards, Inc. (Hamden, CT) and AccuStandard (New Haven, CT). A stock internal standard (ISTD) solution (1000 µg/ml) containing five isotope-labeled standards was purchased from AccuStandard. A stock surrogate standard (SS) solution (2000 µg/ml) containing five isotope-labeled standards was purchased from Absolute Standards, Inc. Approximately 100 µl of a 3.0 µg/ml surrogate working solution was added to each sample (20 ng/g) prior to extraction. An instrument calibration curve (10, 5.0, 2.5, 1.0, 0.25, and 0.10 µg/ml) of the parent and substituted PAHs was prepared by combining the stock PAH spiking solution and the surrogate standard solution in 50% acetone/50% dichloromethane and storing in a chemical refrigerator at 4°C. Approximately 5 µl of the stock ISTD solution was added to each calibration standard and sample prior to analysis. High purity Optima (>99.8 purity) acetone (ACE) and pesticide grade cyclohexane (CH) and dichloromethane (DCM) were purchased from Fisher Scientific (Pittsburg, PA) and used throughout the study. HPLC grade (>99.9% purity) methyl ethyl ketone (MEK) was purchased from Sigma Aldrich (St. Louis, MO). Ultra-pure water was supplied by a Thermo Barnstead MicroPure water purification system (Dubuque, IA).

Commercially available Q-sep QuEChERS AOAC 2007.01 extraction salts (6 g of magnesium sulfate and 1.5 g of sodium acetate per packet) and AOAC 2007.01 sample dispersive SPE tubes (1200 mg of magnesium sulfate, 400 mg of primary secondary amines, and 400 mg of C18 per tube) were obtained from Restek Corporation (Bellefonte, PA). Thermo Scientific Nalgene Oak Ridge round-bottom 50-ml centrifuge

tubes were purchased from Cole-Parmer (Vernon Hills, IL). A Qsonica Q700 sonicator (Atkinson, NH)) equipped with a ¾" horn was used for the low concentration sediment extraction method.

4.2.4 Water Quality Analysis

During each biota and sediment sampling event, water quality measurements were recorded (triplicate) in the vicinity of the Bay Jimmy and Grand Isle sampling locations. Water temperature, specific conductance, salinity, dissolved oxygen (DO), and pH were measured using the YSI model 556 multiparameter meter (Yellow Springs, OH). Turbidity was measured using the Hach 2100P portable turbidimeter (Loveland, CO).

4.2.5 Total Organic Carbon (TOC) Analysis

A single TOC sample was collected from each individual site (sites 1-6) during the seven sampling events. All glassware and ceramic ware used in sample processing were combusted at 400°C for at least 4 hours. Samples remained frozen at 0°C until processing. Sediment samples were thawed and homogenized. The sample was dried in an oven at 40°C. A portion of sample was removed, ground and homogenized. An aliquot of dried, homogenized sample was placed in an aluminum-weighing pan and dried at 105°C. The LECO CR-412 Carbon Analyzer (St. Joseph, MI) was calibrated prior to the analysis of samples. Different amounts of high purity calcium carbonate standard (99.95% purity, carbon content of 12.0%) were used to calibrate the instrument. The approximate amounts of calcium carbonate used for the six-point

calibration were; 0.01 g, 0.05 g, 0.10 g, 0.25 g and 0.50 g. An empty carbon-free combustion boat was analyzed as a blank for the calibration curve. The calibration curve provided an analysis range of approximately 0.0 to 0.06 g total carbon. Each calibration standard must fall within 3% of the known percent carbon value to meet acceptance criteria. A continuing calibration check standard (mid-level standard) was analyzed every ten samples and must be within 5% of the known value of the standard. Total carbon was analyzed by placing approximately 0.350 g of dried, ground and homogenized sample into a clean, carbon-free combustion boat. The sample boat was placed on the autosampler rack assembly and loaded onto the LECO carbon analyzer. Total organic carbon was analyzed by placing approximately 0.350 g of dried, ground and homogenized sample into a clean, carbon-free combustion boat. Each sample boat was treated with phosphoric acid drop by drop until the sample stopped “bubbling” and the sample was completely moist with acid. The sample was placed into an oven set at 40°C for 24 hours and then transferred to an oven set at 105°C. Once the sample was dry, the boat was placed on the autosampler rack assembly and loaded onto the LECO carbon analyzer.

4.2.6 Total Lipid Content

The total lipid content was determined using the Smeded method[119]. A 5.0±0.5 g portion of oyster tissue was homogenized in a Waring blender and weighed into a 50-ml centrifuge tube. Approximately 8 ml of isopropanol and 10 ml of cyclohexane was then added to centrifuge tube and sample homogenized. Approximately 7 ml of deionized water was added and the sample was homogenized again. A centrifuge was used to

separate the organic extract from the particulate material. The organic extract was removed and placed in a pre-weighed flat-bottomed flask. A second extraction was carried out using 25 ml of a 13% (v/v) isopropanol in cyclohexane solution. Again, a centrifuge was used to separate solvent and particulate material. The organic solvent from second extraction was combined with the first extract in the flask. The sample was dried with a rotovap apparatus and the flask was placed in an oven (80°C ± 5°C) for 1 hour. The residual was weighed and the lipid content calculated.

4.2.7 Sample Preparation for Chemical Analysis

4.2.7.1 Biota

The oyster tissue samples were extracted using a modified QuEChERS extraction procedure (AOAC official 2007.01 method). For the modified QuEChERS extraction procedure, the following stepwise procedure was followed: (1) weigh 15.0 g ± 0.1 g of homogenized oyster tissue sample into a clean 50 ml Teflon centrifuge tube; (2) fortify tissue with a 100 µl of 3.0 µg/ml working surrogate solution directly onto the oyster tissue matrix (20 ng/g) and vortex for 2 minutes (min) @ 2,000 revolutions per minutes (rpm); (3) protect from UV light and let stand for 30 minutes; (4) add 15 ml of extraction solvent (30% ACE, 30% MEK, and 40% CH) and vortex for 2 min @ 2,000 rpm; (5) add the contents of a Restek Q-sep QuEChERS AOAC 2007.01 extraction salts packet to 50-ml centrifuge tube, immediately shake for 1 min, then sonicate for approximately 4 minutes; (6) centrifuge the tube at 5,000 rpm for 5 min; (7) transfer 6.4 ml of the solvent extract to a Restek Q-sep Q351 dSPE 15-ml cleanup tube and vortex for 30 seconds; (8) centrifuge for 1 min at 6,000 rpm; (9) transfer 1 ml of the solvent

extract to a 2-ml amber autosampler vial, add 5.0 µl of 2000 µg/ml internal standard solution, cap and store in 4°C refrigerator until analysis. One method blank was prepared per extraction batch (20 samples) by using 15 g of deionized water in place of the tissue matrix. PAH concentrations found in the method blanks were averaged and subtracted from sample results.

4.2.7.2 Sediment

Sediment samples were prepared and extracted according to EPA method 3550C[120]. Approximately 30±0.1 g of sample was placed in a 400-ml beaker and spiked with 1.0 ml of surrogate standard solution (20 µg/ml). Anhydrous sodium sulfate was added and mixed with the sediment sample until a free-flowing sandy texture was achieved. Immediately following mixing, a 100 ml volume of 1:1 acetone: dichloromethane extraction solution was added to the beaker. The ¾" disruptor horn was placed approximately ½" below the surface of the solvent, but above the sediment layer. The sample was extracted for 3 min, with output set at full power on pulse mode at 50% duty cycle (energy on 50% of time and off 50% of time). The extract was filtered through a glass funnel lined with Whatman No. 41 filter paper into a clean 500-ml flat-bottomed flask. If water was observed in the solvent extract, anhydrous sodium sulfate should be added to the glass funnel prior to filtering. The extraction process was repeated two more times with additional 100-ml portions of clean solvent. The 500-ml flat-bottomed flask was placed on a Buchi rotavapor R-210 (Flawil, Switzerland) and solvent extract concentrated to approximately 5-8 ml volume. The solvent extract was transferred to a 15-ml graduated centrifuge tube and concentrated to a final volume of 1

ml using a nitrogen blow-down system (Phoenix Scientific N-Evap, Bangkok, Thailand). The 1-ml final extract was transferred to a 2-ml amber autosampler vial, spiked with 5.0 µl of 2000 µg/ml internal standard solution, and capped and stored in a 4°C refrigerator until analysis. One method blank was prepared per extraction batch (20 samples) by using 15 g of cleaned sand in place of the sediment matrix. PAH concentrations found in the method blanks were averaged and subtracted from sample results.

4.2.8 GC-MS Analyses

All calibration standards and samples were analyzed using an Agilent GC-MS system equipped with a 7890A GC and 5975C MS detector (Santa Clara, CA) operating in positive ion mode with electron impact ionization (70 eV). Mass spectral data was acquired utilizing selective ion monitoring (SIM) and DB-5MS capillary column (30 m length, 0.25 µm film thickness, 0.25 mm i.d., Agilent J&W). The injection port was operated in the pulsed splitless mode, fitted with a 2 mm glass liner with deactivated glass wool, and delivered a 1-2 µl injection via an Agilent 7683B Series autosampler to an inlet maintained at 280 °C. The chromatographic conditions were the following: He carrier gas constant flow 1.0 ml/min, the initial oven temperature was 70 °C, 2 min hold, ramp to 280 °C at 6 °C/min, 3 min hold, and ramp to 300 °C at 3 °C/min for a final run time of 46.67 min. Mass spectrometer transfer line, source, and quadruple temperature were 280 °C, 230 °C, and 150 °C, respectively. PAH SIM quantitation and confirmation ion are shown in table 2-1 along with retention times and percent relative standard deviation (% RSD). The method detection limits for the individual PAHs ranged from 0.5 to 2.0 ng/g (ppb).

4.2.9 Quality Control

All biota and sediment samples were collected in triplicate and all measurements were run in in triplicate for standards and samples. PAH concentrations were calculated and expressed in µg/Kg dry weight. The analytical blanks were processed in the same manner as the samples and concentrations were determined using standard solutions. The surrogate recoveries for PAHs during these experiments were found to be between 82-103%; no samples were outside these limits.

4.2.10 Statistical Analysis

Results of PAH concentrations, biochemical parameters, and water quality parameters were analyzed using SPSS 22.0 (SPSS INC., Chicago, IL) software. T-test, one-way and two-way ANOVA, and Pearson correlation coefficients were used to examine differences between spatial, temporal, and ploidy observations and PAH concentrations. A significance level of 95% was used.

4.3 Results and Discussion

4.3.1 Water Quality

The system-wide mean (±SD) water temperature was 25.5 ± 4.9°C. The highest and lowest observed water temperatures were 30.2°C at the GI site on July 2011 and 13.7°C at the BJ site on February 2012, respectively (Figure 4.3). There was no difference in mean (±SD) water temperature between the BJ and GI sites. Among sampling dates, there was significant differences ($p<0.05$) between the winter sampling

events (November 2011 and February 2012) and the remaining dates. The system-wide mean (±SD) salinity for the sampling period was 15.4 ± 7.2 (Figure 4.4). The lowest and highest salinity observed were 2.8 at the BJ site on February 2012 and 27.1 at the GI site on November 2011, respectively. There was a significant difference ($p<0.05$) in mean (±SD) salinity between the BJ and GI sites during the sampling period. Among sampling dates, there was significant differences ($p<0.05$) in salinity between all sampling dates at both sites. The system-wide mean (±SD) specific conductance (µS/cm) for the sampling period was 25282 ± 11011 (Figure 4.5). The lowest and highest salinity observed were 5069 µS/cm at the BJ site on February 2012 and 41600 µS/cm at the GI site on November 2011, respectively. There was a significant difference ($p<0.05$) in mean (±SD) salinity between the BJ and GI sites during the sampling period. Among sampling dates, there was significant differences ($p<0.05$) in salinity between all sampling dates at both sites. The system-wide mean (±SD) dissolved oxygen (mg/L) for the sampling period was 4.7 ± 0.9 (Figure 4.6). The lowest and highest dissolved oxygen observed were 3.0 at the GI site on July 2011 and 6.6 at the BJ site on May 2012, respectively. There was no difference in mean (±SD) dissolved oxygen between the BJ and GI sites. Among sampling dates, there was significant differences ($p<0.05$) between the sampling event on May 2012 and the remaining dates. The system-wide mean (±SD) pH for the sampling period was 6.9 ± 0.4 (Figure 4.7). The lowest and highest pH observed were 7.5 at the GI site on 30 May 2012 and 6.1 at the BJ site on August 2011, respectively. There was no difference in mean (±SD) pH between the BJ and GI sites or among the sampling dates. The system-wide mean (±SD) turbidity (NTU) was 181 ± 63.2. The lowest and highest

observed turbidity were 313 NTU at the BJ site on September 2012 and 87.3 NTU at the GI site on February 2012, respectively (Figure 4.8). There was a significant difference ($p<0.05$) in mean (±SD) turbidity between the BJ and GI sites. Among sampling dates, there was significant differences ($p<0.05$) between the storm-related sampling events (September 2011, August 2012, and September 2012) and the remaining dates. A summary of water quality field results for Bay Jimmy and Grand Isle sites (Tables A.11) is located in the appendix.

There was a strong correlation (r = 0.992) between the salinity and specific conductance within the Bay Jimmy and Grand Isle sampling locations, as noted by the Pearson correlation results. This is expected since specific conductivity is an indirect measurement of salinity and NA^+ and Cl^- are the predominant ions in natural seawater. Change in salinity levels coincide with Louisiana's typical precipitation cycle, low rainfall in the winter months (September-January) with increased rainfall occurring during the spring and early summer months (February-June). Above average turbidity readings were recorded at both BJ and GI sites during the September 2011, August 2012, and September 2012 sampling events. The elevated turbidity at the Bay Jimmy sites was attributed to the excessive hydraulic energy and resulting marsh erosion produced by Tropical Storm Lee (04 September 2011) and Hurricane Isaac (29 August 2012). The turbidity measured at the Grand Isle site was elevated above the site average but was not effected as much as the Bay Jimmy locations due to its protective location on the backside of the barrier island.

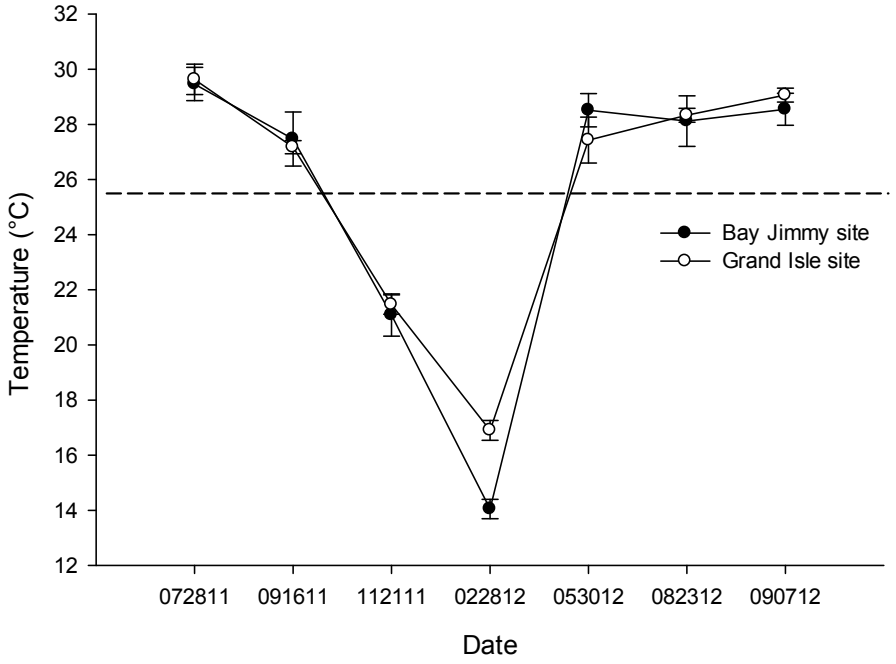

Figure 4.3 Mean (±SD) temperature of Bay Jimmy and Grand Isle sites for the sampling period. Dashed line represents the overall mean temperature for the sampling period.

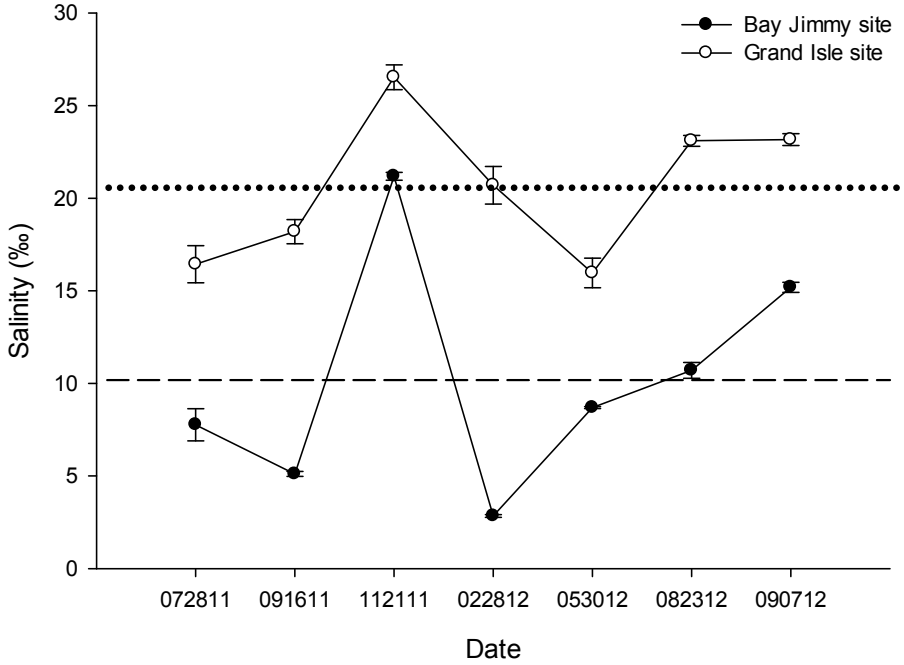

Figure 4.4 Mean (±SD) salinity of Bay Jimmy and Grand Isle sites for the sampling period. Dashed line represents the overall mean temperature for the sampling period.

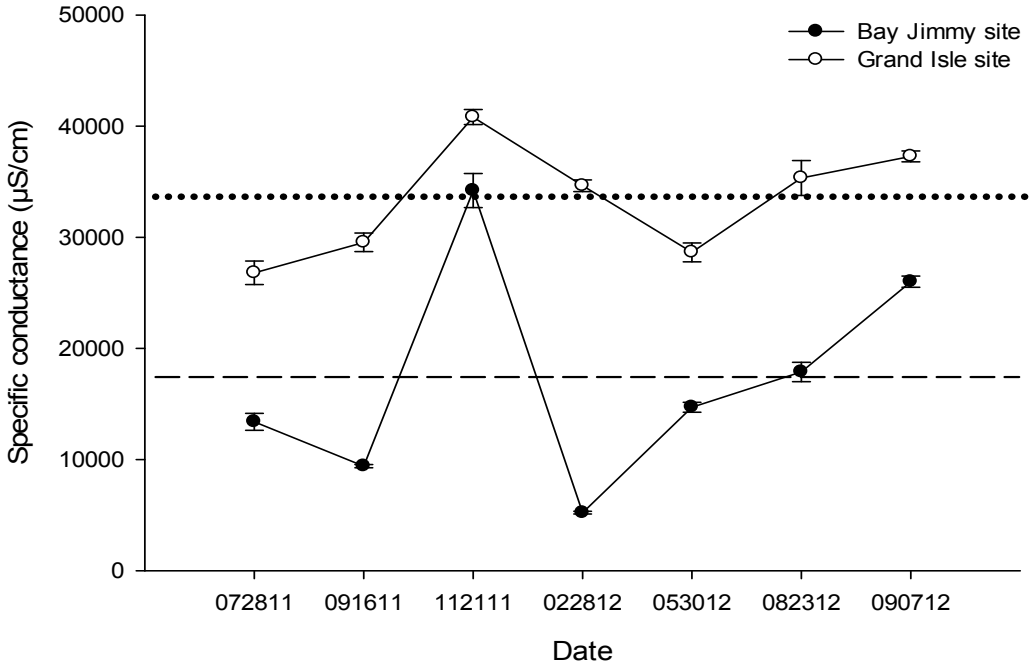

Figure 4.5 Mean (±SD) specific conductance of Bay Jimmy and Grand Isle sites for the sampling period. Dashed line represents the overall mean temperature for the sampling period.

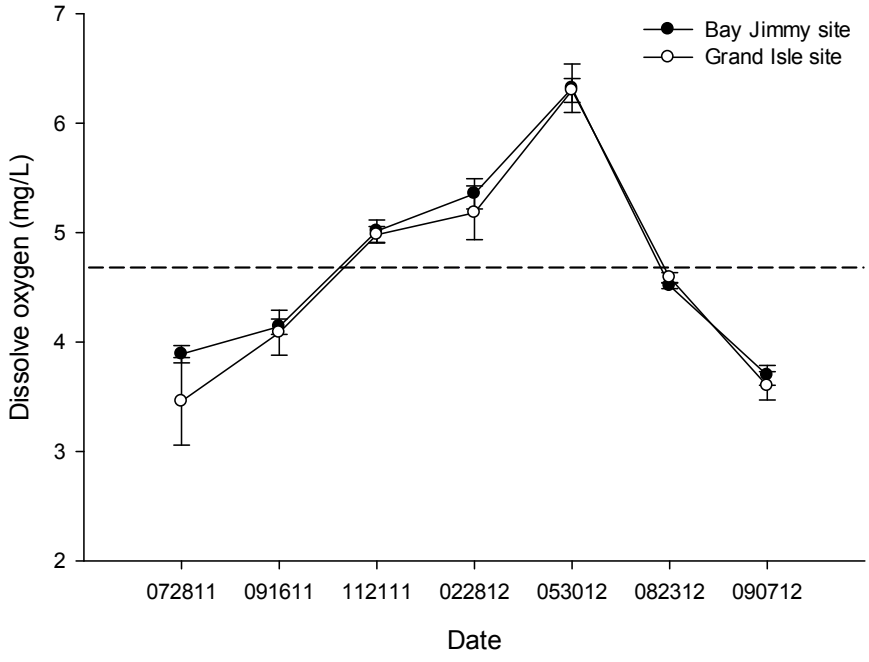

Figure 4.6 Mean (±SD) dissolve oxygen of Bay Jimmy and Grand Isle sites for the sampling period. Dashed line represents the overall mean temperature for the sampling period.

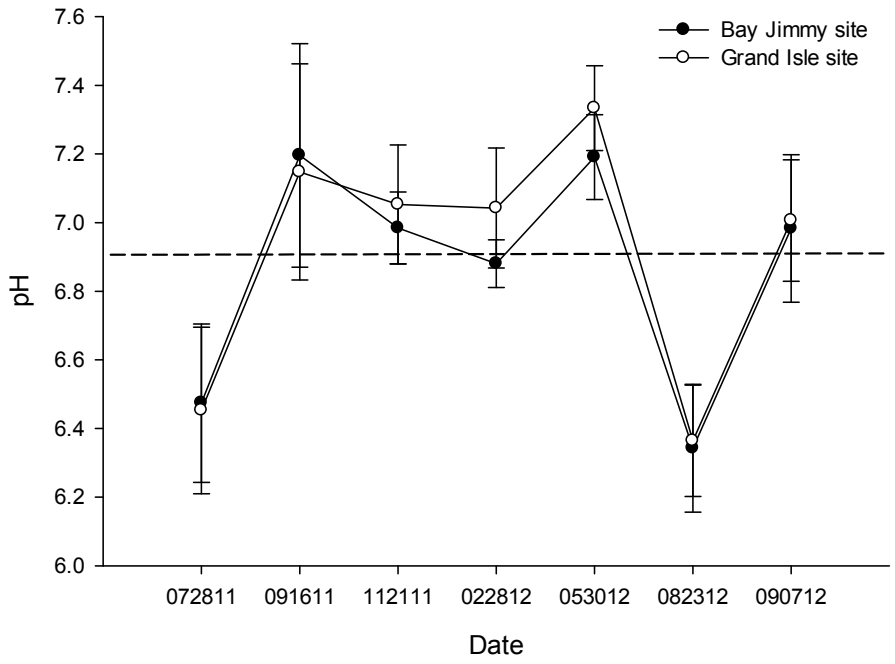

Figure 4.7 Mean (±SD) pH of Bay Jimmy and Grand Isle sites for the sampling period. Dashed line represents the overall mean temperature for the sampling period.

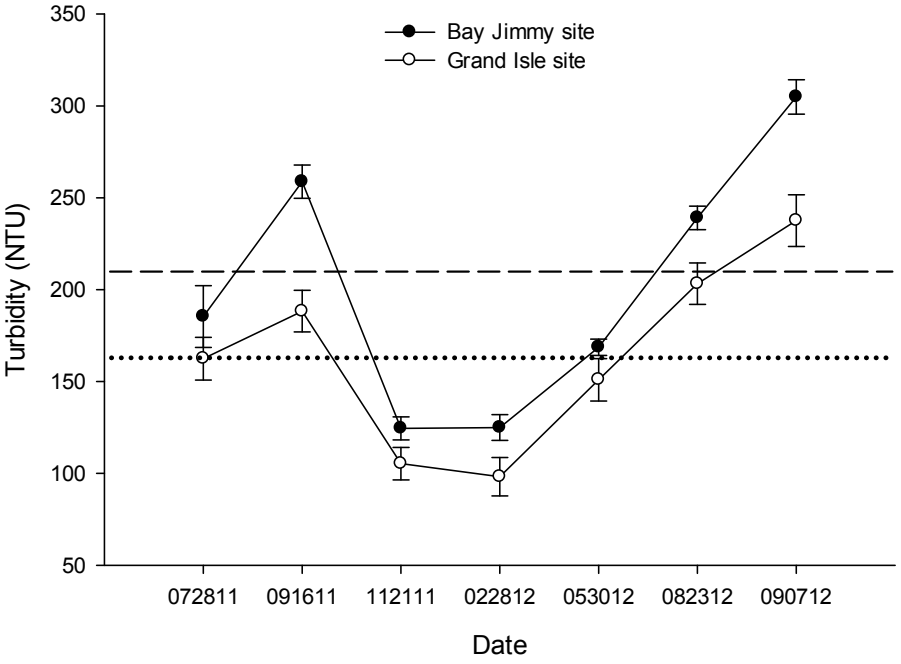

Figure 4.8 Mean (±SD) turbidity of Bay Jimmy and Grand Isle sites for the sampling period. Dashed line represents the overall mean temperature for the sampling period.

4.3.2 PAH Levels in the Sediments of Barataria Bay Sites

The PAH distribution between the two Barataria Bay sites (Bay Jimmy and Grand Isle) is very dissimilar. The Bay Jimmy location mean (±SD) sediment PAH concentration (µg/Kg) for the sampling period was 438 ± 113 µg/Kg. The surface sediments present a wide range of total target PAH concentrations, ranging from 234 to 734 µg/Kg of dry matrix for the 7 sampling events (Figure 4.9). PAH contamination levels comparable to the Bay Jimmy sites were measure in 2010 and 2011[121], following the *Deepwater Horizon* spill, for sediment samples collected at nearby locations in Louisiana and Mississippi. The Grand Isle location mean (±SD) sediment PAH concentration (µg/Kg) for the sampling period was 60.9 ± 6.81 µg/Kg. The total target PAH concentrations of surface sediments for the GI site are significantly lower than the BJ sites, ranging from 75.7 to 47.9 µg/Kg of dry matrix for the 7 sampling events (Figure 4.9). This lower contamination level may be partly due to the mixing of Barataria Bay waters and Gulf of Mexico sea water, leading to dilution of the contamination. In addition, the coarse silty fine sands characteristic of the barrier island are known to accumulate hydrophobic contaminants to a lesser extent than the silty mud sediments found in Bay Jimmy.[122] The average water content (% moisture) in the sediments from the Bay Jimmy and Grand Isle sites for the sampling period were 63.2 ± 6.8% and 43.7 ± 8.6%, respectively. The summaries of the tabulated PAH results for the sediments (Tables A.12-18) are located in the appendix.

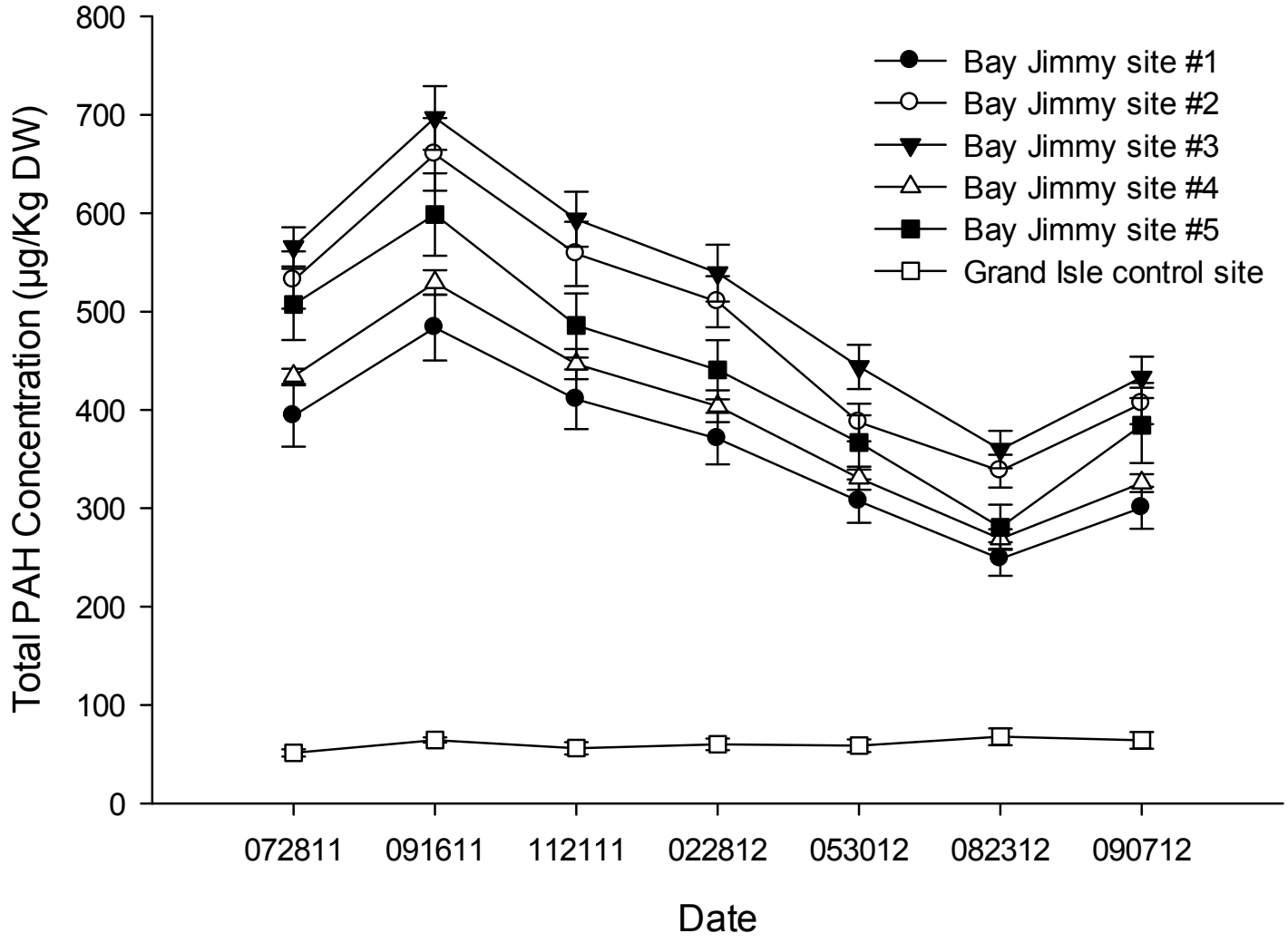

Figure 4.9 Total target PAH concentrations in sediments at the Bay Jimmy and Grand Isle sites for the sampling period.

4.3.3 Origins of the Sediment Contamination in Barataria Bay

There are three main processes by which PAHs are generated: (1) combustion of organic matter at extremely high temperatures; (2) release of naturally occurring petroleum; or (3) biogenic processes[123]. Crude oils from various regions or geological fields differ in the plant and animal source materials, as well as the time, temperature, and pressure conditions that occurred during formation. Therefore, each crude oil has a unique molecular pattern or fingerprint that can potentially be determined using biomarkers. Petroleum biomarkers are “molecular fossils”; they are complex hydrocarbon molecules that retain a remarkable structural similarity to the original natural product formed from dead organisms in the source rock. Due to variations in geologic formations and conditions, each crude oil would exhibit a unique set of hopane (*m/z* 191) and sterane (*m/z* 217) biomarker ‘‘fingerprints’’. These biomarkers, which are highly resistant to weathering and degradation, are utilized by environmental forensic chemists to fingerprint crude oils, providing valuable information when evaluating source oils, weathered oils, and tarball source identification. Also, the parent PAH patterns generated by each petroleum source make it possible for scientist to “fingerprint” or determine the process (i.e. pyrogenic or petrogenic) that produce PAHs when studying sediment contamination.

Multiple factors, such as chemical composition of the organic matter or temperature, affect quantity and distribution of PAHs formed incomplete combustion processes or during its thermal maturation in the earth. Thermal PAH formation can occur over a wide range of temperatures. Sediments contaminated by pyrogenic sources display an aromatic hydrocarbons profile dominated by unsubstituted PAHs

with a broad molecular range, up to the hexa-aromatics, and even higher molecular weight compounds[124]. In contrast, sediments contaminated with sources formed by natural, slow maturation processes (i.e. crude oils) are dominated by the lower molecular weight aromatic hydrocarbons with a complete suite of alkylated PAHs. The study of the PAH distribution and biomarker patterns can provide investigators with vital information on the process and source from which these contaminants originated. The compounds fluorene (Flu), phenanthrene (Phe), anthracene (Ant), fluoranthene (Flt), pyrene (Pyr), benzo[a]-pyrene (Bap), and indeno [cd] pyrene (Inp) at the BJ sites yielded a relatively good correlation (r >0.5) with ΣPAH values. These result suggests that the compositions of the major PAHs are fairly constant at different sampling sites and may come from the similar sources.

To determine the origins of the sediment contaminants detected at the BJ and GI sites, the ratios of Phe/Ant and Flt/Pyr were calculated. These ratios have been used extensively to distinguish petrogenic and pyrogenic sources of PAHs. A ratio of Phe/Ant < 10 and Flt/Pyr > 1 tends to indicate that the PAH contamination is from combustion processes[125]. As shown in Fig. 4.10, all of the Bay Jimmy sampling sites displayed Phe/Ant ratios > 10 and Flt/Pyr ratios < 1, suggesting significant PAH inputs from petrogenic sources into the northern Barataria Bay region. The results suggest that PAHs in the Grand Isle location are derived from the combustion of fossil fuels. The PAH contamination in the Grand Isle region most likely related to the high volume of recreational and commercial boat traffic surrounding the sampling site. In order to determine if the Bay Jimmy and Grand Isle sites were contaminated with PAHs as a result of the *Deepwater Horizon* spill, oil fingerprint profiles of sediment samples from

the Bay Jimmy and Grand Isle sites were compared to South Louisiana crude (SLC) source oil obtained from the *Deepwater Horizon* spill. As Illustrated by Figure 4.11, the hopane (*m/z* 191) from the Bay Jimmy sediment profile is a positive match to the *Deepwater Horizon* spill source oil profile. The Grand Isle sediment profile does not display any of the characteristics found in the *Deepwater Horizon* spill source oil profile. The results suggest that PAH inputs in the Bay Jimmy area are derived mainly from the *Deepwater Horizon* spill. The PAH inputs in the Grand Isle area are derived from combustion of fossil fuels, and these material may originate from vessel traffic in the area.

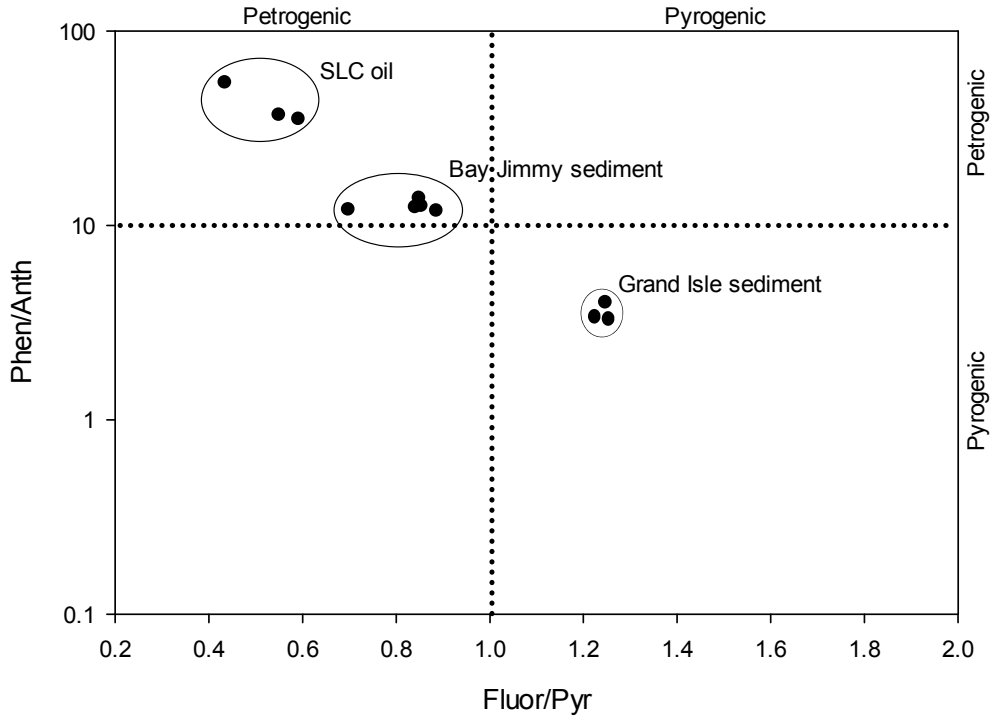

Figure 4.10 Double ratio source plot for Bay Jimmy and Grand Isle sediment. SLC oil represents source oil spilled during Deepwater Horizon spill.

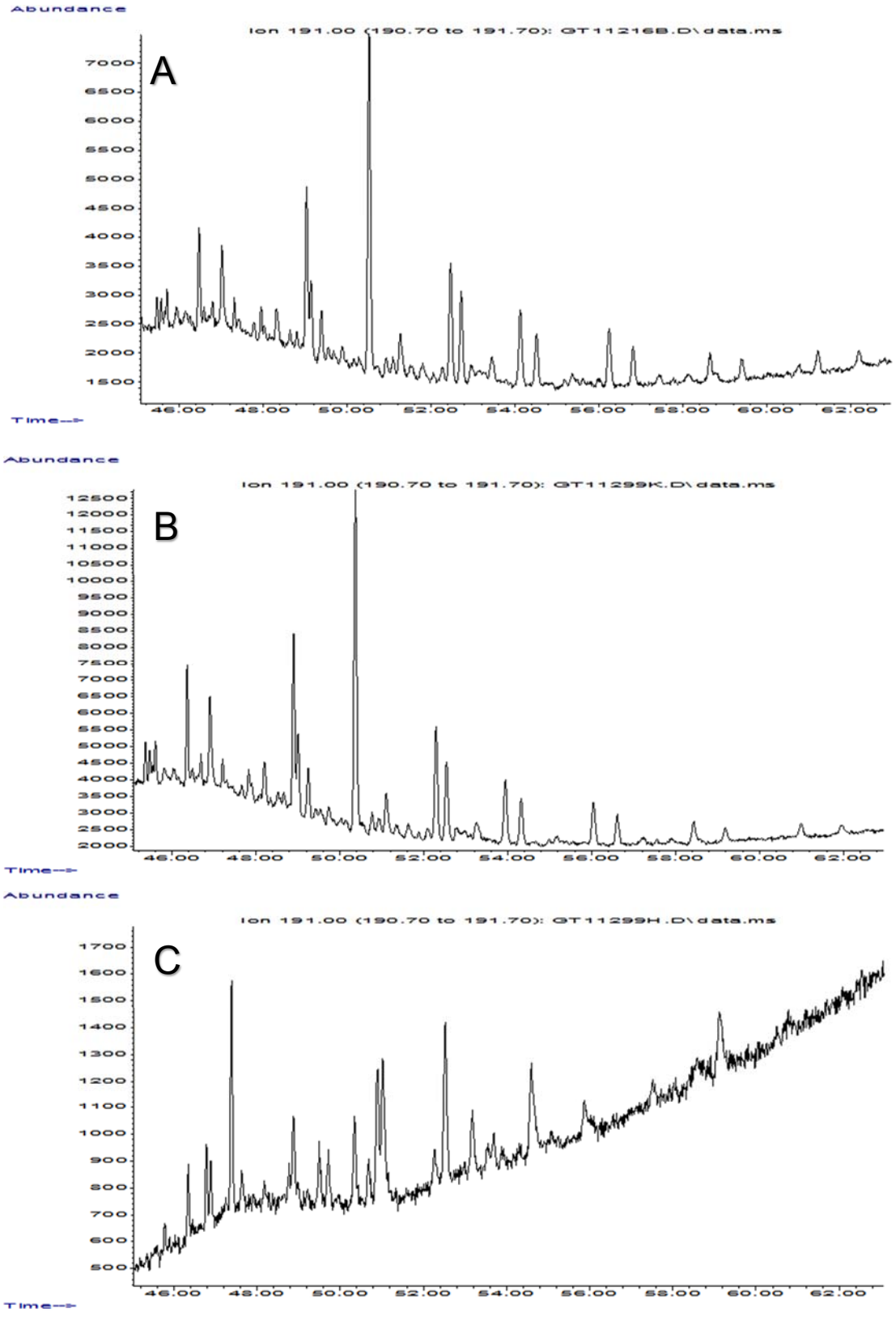

Figure 4.11 Hopane (m/z 191) biomarker profile of: (A) South Louisiana crude (SLC) source oil; (B) Bay Jimmy sediment; (C) Grand Isle sediment.

4.3.4 Caged Oyster Total PAH Levels

Prior to transplanting oysters at the experimental sites, both ploidy (5 replicates each) were processed and analyzed for PAH content. The baseline mean (±SD) total PAH content for diploid and triploid oysters were 33.5 ± 6.32 µg/Kg and 37.1 ± 5.89 µg/Kg, respectively. The oyster total PAH content in the caged diploid oysters at the Bay Jimmy sites had a mean (±SD) tissue PAH concentration (µg/Kg) for the sampling period of 80.7 ± 22.0 µg/Kg (Figure 4.12). The BJ diploid tissue total PAH content ranged from 40.8 to 127 µg/Kg of dry matrix for the 7 sampling events. The lower diploid tissue PAH concentration was recorded during the August 2012 sampling event (site #1), at the end of the field experiment. The highest diploid tissue PAH concentration was recorded during the 21 November 2011 sampling event (site #3). The oyster total PAH content in the caged diploid oysters at the Grand Isle site had a mean (±SD) tissue PAH concentration (µg/Kg) for the sampling period of 35.4 ± 4.57 µg/Kg. The GI diploid tissue total PAH content ranged from 28.3 to 44.7 µg/Kg of dry matrix for the 7 sampling events. The lower diploid tissue PAH concentration was recorded during the September 2012 sampling event (site #6), at the end of the field experiment. The highest diploid tissue PAH concentration was recorded during the August 2012 sampling event (site #6).

The oyster total PAH content in the caged triploid oysters at the Bay Jimmy sites had a mean (±SD) tissue PAH concentration (µg/Kg) for the sampling period of 88.3 ± 22.6 µg/Kg (Figure 4.13). The BJ triploid tissue total PAH content ranged from 47.5 to 147 µg/Kg of dry matrix for the 7 sampling events. The lower triploid tissue PAH concentration was recorded during the August 2012 sampling event (site #1), at the end

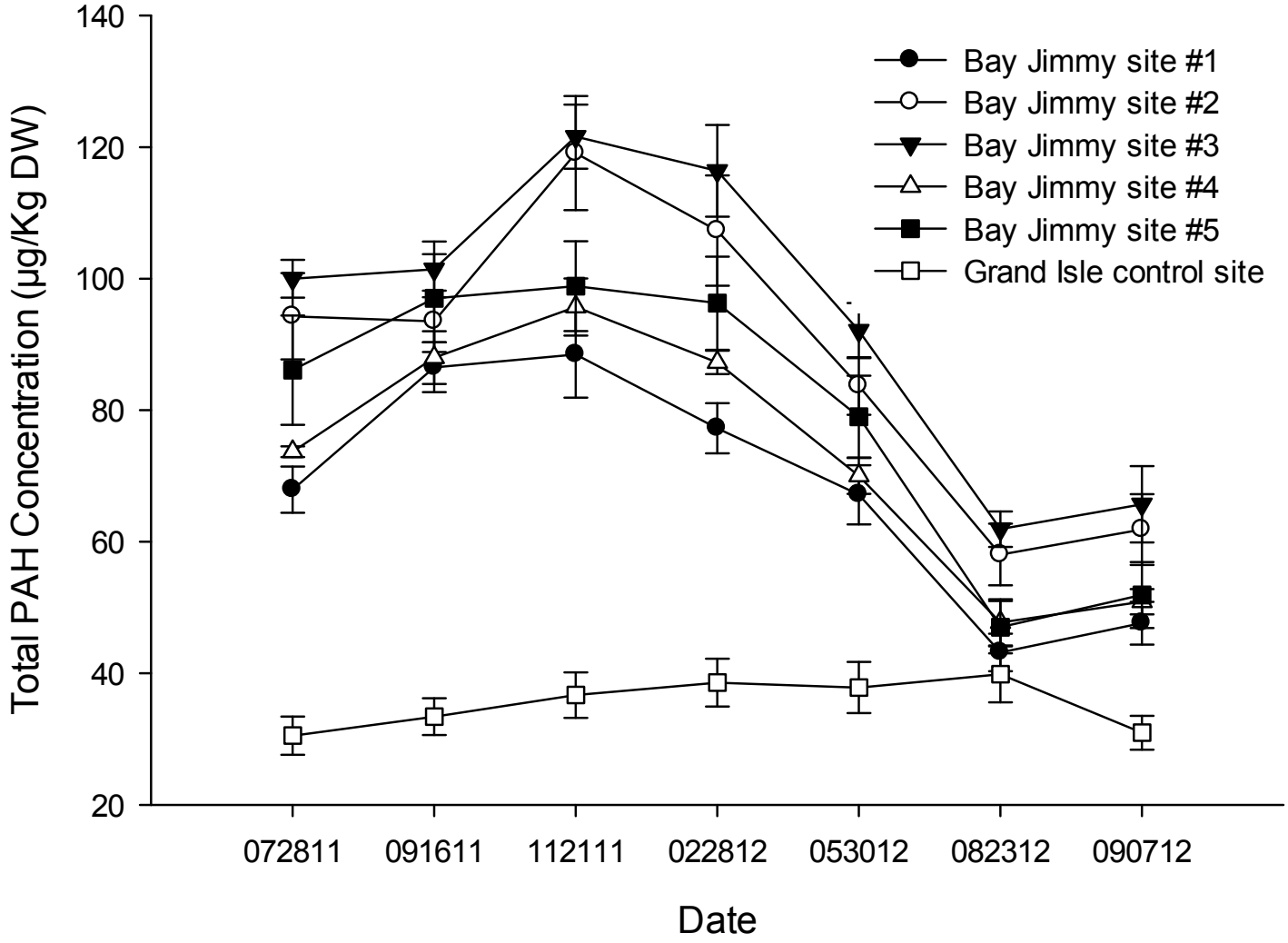

Figure 4.12 Total target PAH concentrations in diploid oysters at the Bay Jimmy and Grand Isle sites for the sampling period.

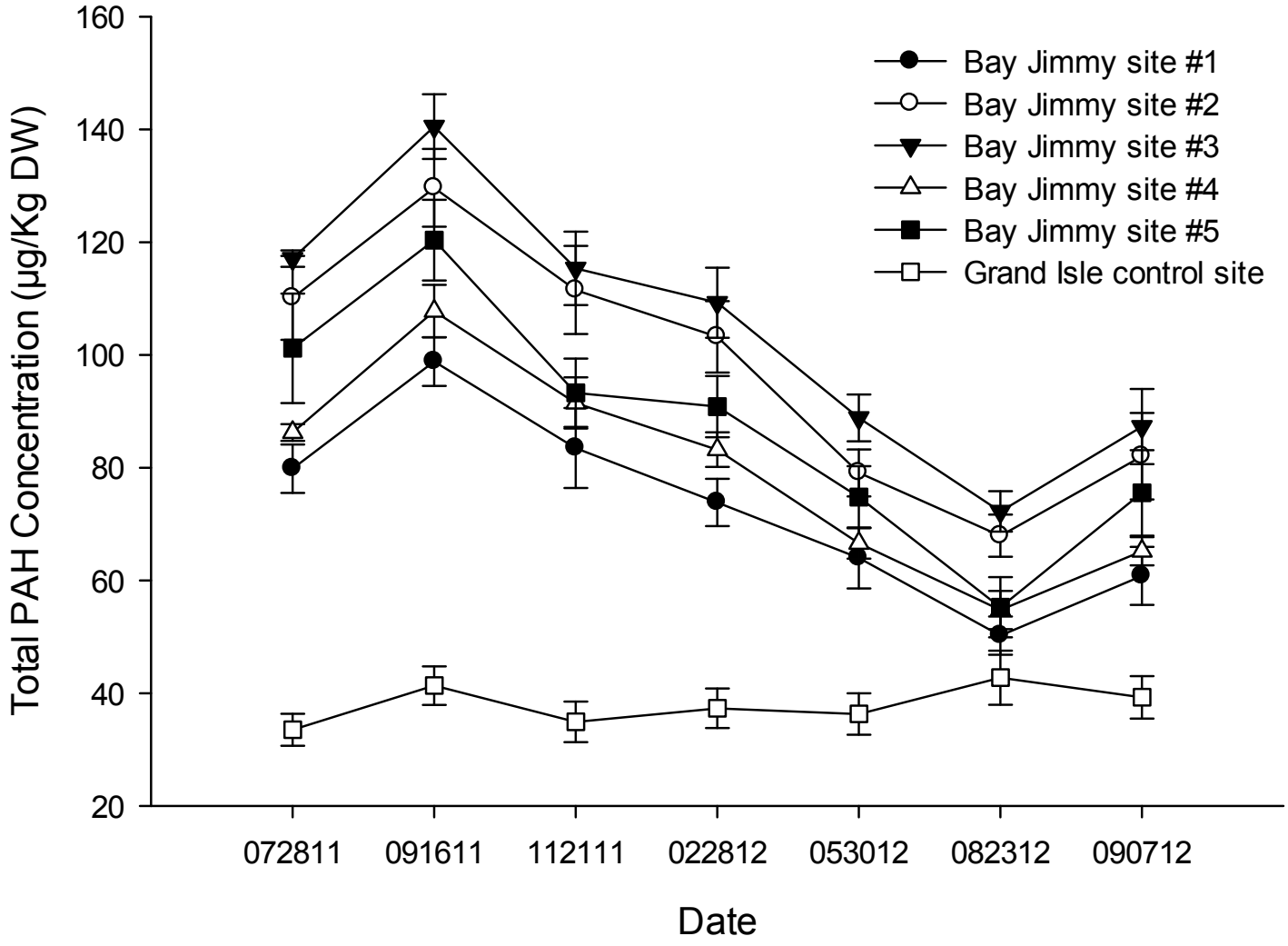

Figure 4.13 Total target PAH concentrations in triploid oysters at the Bay Jimmy and Grand Isle sites for the sampling period.

of the field experiment. The highest diploid tissue PAH concentration was recorded during the September 2011 sampling event (site #3). The oyster total PAH content in the caged triploid oysters at the Grand Isle site had a mean (±SD) tissue PAH concentration (µg/Kg) for the sampling period of 37.9 ± 4.45 µg/Kg. The GI triploid tissue total PAH content ranged from 31.8 to 48.3 µg/Kg of dry matrix for the 7 sampling events. The lower triploid tissue PAH concentration was recorded during the July 2011 sampling event (site #6), at the beginning of the field experiment. The highest diploid tissue PAH concentration was recorded during the August 2012 sampling event (site #6). The summaries of the tabulated PAH results for the diploid (Tables A.19-25) and triploid (Tables A.26-32) oysters are located in the appendix.

A statistical analysis was performed on the total PAH content of the oysters to determine whether there are differences between the ploidy (diploid and triploid). Results indicated there was a significant difference ($p < 0.05$) in total PAH content between the sampling events, both Bay Jimmy and Grand Isle locations. There was no significant difference ($p>0.05$) between the Bay Jimmy sites (sites 1-5), but there was an observed difference ($p<0.05$) between the Bay Jimmy sites (sites 1-5) and Grand Isle site (site 6). A more detailed analysis of all the oysters (diploid and triploid) from the Bay Jimmy site showed there was a significant difference ($p<0.05$) between total PAH content for the diploid and triploid oysters during the July 2011, September 2011, August 2012, and September 2012 sampling events. The remaining sampling events at the Bay Jimmy site showed there was no significant difference ($p>0.05$) between the ploidy. An analysis of all the oysters (diploid and triploid) from the Grand Isle site showed there was a significant difference ($p<0.05$) of total PAH content for the diploid

and triploid oysters during the September 2011 and September 2012 sampling events. The remaining sampling events at the Grand Isle site showed there was no significant difference ($p>0.05$) between the ploidy.

The contamination levels within the oysters were different according to the various sampling events. The highest total PAH concentrations (for BJ sites) in diploid oysters were measured during the November 2011 sampling event with a mean (±SD) of 105 ± 14.7 µg/Kg. The August 2012 and September 2012 sampling events were much lower, with the mean (±SD) total PAH concentrations measuring 60.1 ± 9.38 µg/Kg and 55.6 ± 8.14 µg/Kg, respectively. The highest total PAH concentrations (for BJ sites) in triploid oysters were measured during the September 2011 sampling event with a mean (±SD) of 119 ± 16.2 µg/Kg. The August 2012 and September 2012 sampling events were much lower, with the mean (±SD) total PAH concentrations measuring 51.6 ± 8.00 µg/Kg and 74.2 ± 11.6 µg/Kg, respectively. The lipid concentrations (Figure 4.14) within the diploid oysters varied from 8.4 to 15.6%, with a significant difference ($p<0.05$) over the sampling period. In contrast, the triploid oysters did not exhibit any significant temporal variation over the sampling period, ranging from 8.9 to 11.3%. A summary of the tabulated lipid content results for the diploid and triploid oysters (Table A.33) is located in the appendix.

The temporal differences in PAH concentration levels within the oysters (diploid and triploid) could be linked to many factors, including increased contamination uptake due to a high lipid content in tissues, dilution of contaminant levels by high lipid concentrations, increased exposure due to meteorological events, or influences by the oyster's (diploid) reproductive cycle. There was no observed increase in PAH content

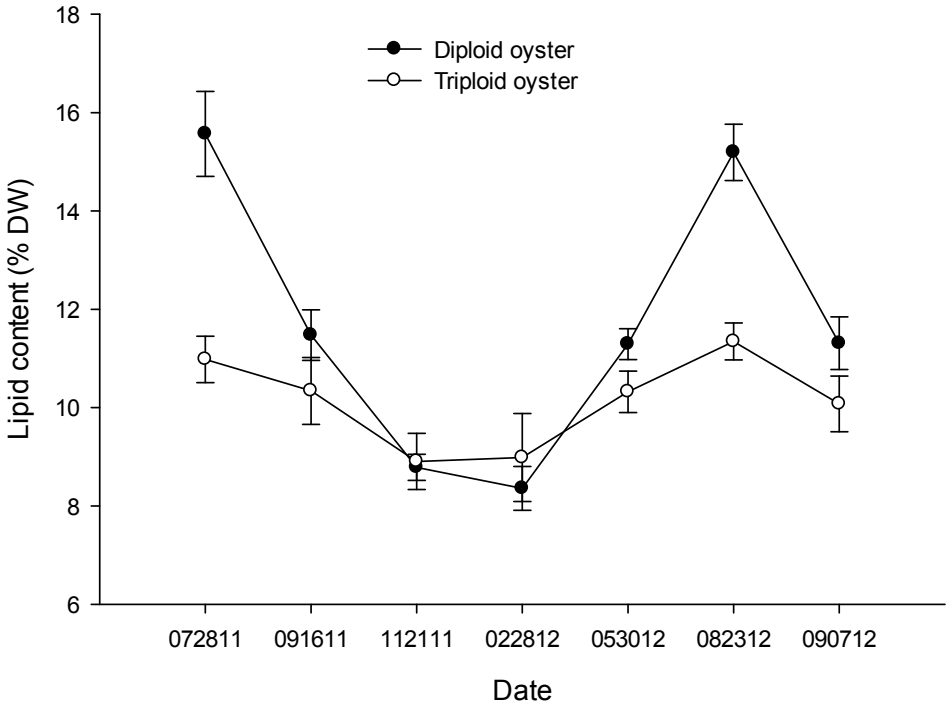

Figure 4.14 Lipid content in diploid and triploid oysters at the Bay Jimmy and Grand Isle sites for the sampling period.

within the diploid oysters during the summer season (May-September), indicating there was little or no influence by high lipid concentrations. In comparison to the same time period, the triploid oysters maintained a constant level of PAHs within their tissue.

During storm events, strong tidal surges and currents resuspend contaminated sediment particles and made them readily available to the filter-feeding organisms. The diploid and triploid oyster total PAH content was plotted versus the sediment total PAH content (Figures 4.15 and 4.16). Oyster (diploid and triploid) and sediment total PAH content are positively correlated. The Pearson correlation coefficient (*r*) for the diploid and triploid versus the sediment was 0.9032 and 0.9765, respectively. The most contaminated oysters were located in the sites where the sediments are contaminated

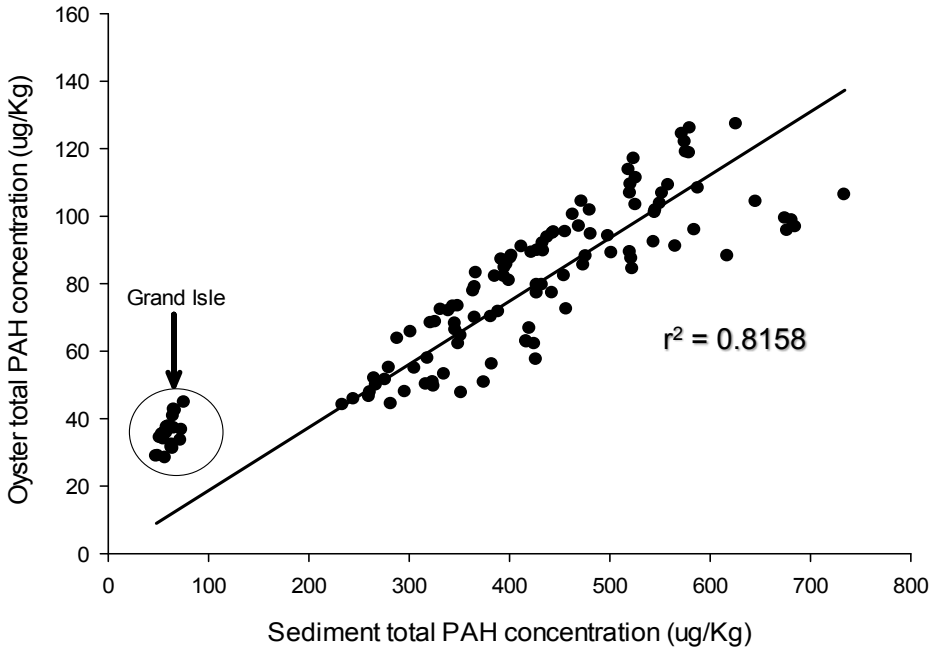

Figure 4.15 Plot of diploid oyster total PAH concentrations versus sediment total PAH concentrations for all sites.

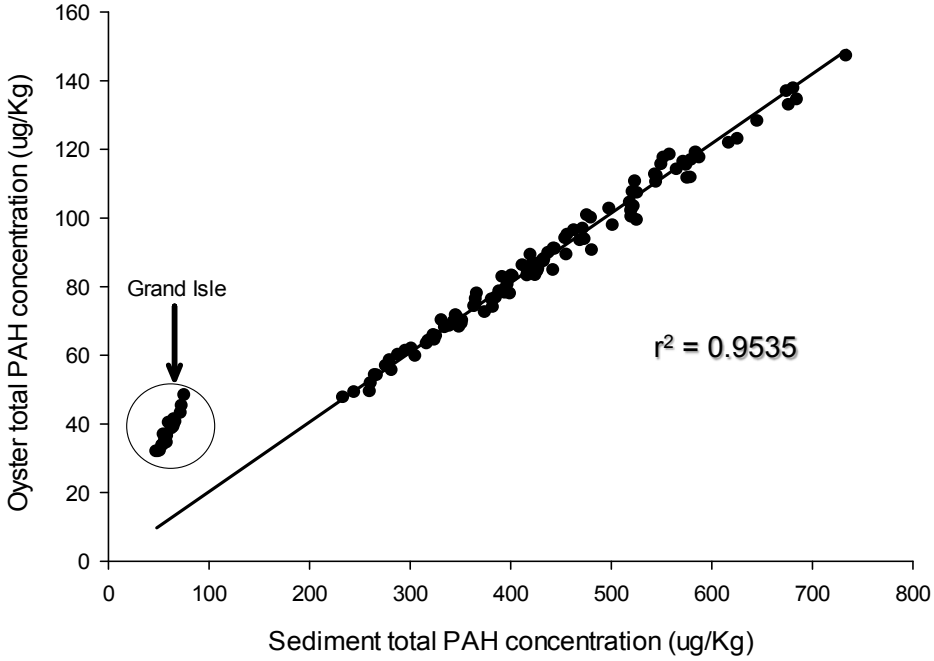

Figure 4.16 Plot of triploid oyster total PAH concentrations versus sediment total PAH concentrations for all sites.

at the highest levels. Oyster tissue content results from an equilibrium between uptake, assimilation, and depuration. Therefore, it is valid to state that the most contaminated oysters will be located in the most contaminated sites. A significant spike (17-24%) in PAH concentrations, within the triploid oysters, was observed following Tropical Storm Lee and Hurricane Isaac. In comparison, the diploid oysters showed only a slight increase (3-10%) in PAH content following the storm events. The results indicate a link between the storm events (sediment resuspension) and increased PAH levels in triploid oysters. The lack of significant PAH uptake by the diploid oysters may be linked to changes in metabolic rates experienced during their reproductive cycle.

Diploidy and triploidy biochemical physiology and reproductive cycles differ greatly. During the winter month diploid oysters typically increase their glycogen and lipid levels in anticipation of gametogenesis which begins in late March and continues into May-June, when spawning occurs, depending on environmental factors (water temperature, salinity, chlorophyll levels). The accumulation of lipid content is directly related to bivalve maturation stage, with a maximum value occurring just prior to spawning. Following spawning, the biochemical composition (lipids, glycogens, and protein) are reduced and the organism typically becomes stressed and susceptible to disease[96,126]. The % change in diploid and triploid total PAH content for the individual sampling dates and sites are shown in Table 4.2. Significant increases (17.2-33.4%) in total PAH content within the triploid oysters were observed at the Bay Jimmy sites for the months coinciding with the spawning season (June-September) and elevated lipids levels in the diploid oysters. Increases (23.8-26.9%) in total PAH content at the Grand Isle site was only observed for the September 2011 and 2012 sampling events. The

Table 4.2 Percent change in diploid and triploid total PAH content for the individual sampling dates and sites.

Date	Site	ΣPAH_{dip}	ΣPAH_{trip}	% Change	Site % Change
072811	1	67.9	79.8	17.5	
	2	94.3	110	16.8	
	3	100	117	17.1	17.2
	4	73.7	86.3	17.0	
	5	86.1	101	17.5	
	6	30.5	33.5	9.8	9.81
091611	1	86.5	98.9	14.2	
	2	93.5	130	38.7	
	3	101	141	38.5	27.6
	4	88.0	108	22.5	
	5	97.0	120	24.1	
	6	33.4	41.3	23.8	23.8
112111	1	88.5	83.5	5.6	
	2	119	112	6.3	
	3	122	115	5.1	5.43
	4	95.7	91.5	4.4	
	5	98.9	93.3	5.6	
	6	36.7	34.9	4.8	4.82
022812	1	77.3	73.8	4.5	
	2	107	103	3.8	
	3	116	109	6.1	4.93
	4	87.3	83.2	4.6	
	5	96.3	90.9	5.6	
	6	38.6	37.3	3.3	3.26
053012	1	67.1	64.0	4.7	
	2	83.7	79.1	5.5	
	3	92.1	88.9	3.5	4.81
	4	70.0	66.6	4.9	
	5	79.0	74.8	5.4	
	6	37.8	36.3	4.1	4.06
082312	1	43.2	50.2	16.3	
	2	58.1	67.9	17.0	
	3	61.9	72.2	16.7	16.4
	4	47.7	54.7	14.7	
	5	47.0	55.2	17.5	
	6	39.8	42.7	7.3	7.30
090712	1	47.6	60.8	27.7	
	2	61.8	82.1	32.7	
	3	65.7	87.3	32.9	33.4
	4	50.9	65.2	28.1	
	5	51.9	75.6	45.6	
	6	31.0	39.3	26.9	26.9

lack of PAH increases in triploid tissue at the Grand Isle site for the July 2011 and August 2012 sampling events may be explained by an apparent baseline level for oyster PAH content of about 30-40 µg/Kg. This baseline level is a result of a balance between uptake and depuration of contaminants. The change in diploid and triploid PAH concentrations (3.26-5.43%) were not significantly different ($p>0.05$) for the November 2011, February 2012, and May 2012 sampling events.

4.3.5 Oyster Bioaccumulation Factors

As noted earlier, the Pearson correlation (*r*) between oysters and sediment total PAH concentrations is high (diploid=0.9665, triploid=0.9765). The high correlation between the sediment and oysters is mainly due to the oyster's proximity to the oiled shoreline and to a possible higher concentration of suspended particles in the water column. The graphs for the PAH concentrations in oysters (Figures 12 & 13) display comparable trends. An increase in PAH content was observed in the diploid oysters during the winter months (November 2011 and February 2012 sampling). The elevated PAH concentrations may be related to their high-filtering rates (increased feeding rate) during the winter months. A slight decrease in PAHs was recorded by the triploid oysters for the same time period. In order to determine oyster accumulation from the surrounding sediment, bioaccumulation factors (BAF) were calculated. BAFs are the ratio of oyster total PAH concentration versus the sediment total PAH concentration (dry wt.). The bioaccumulation factors at the Bay Jimmy and Grand Isle sites ranged from 0.13 to 0.64 for the diploid oysters and 0.19 to 0.66 for the triploid oysters (Table 4.3). This broad range for BAFs is due the contrast in the Bay Jimmy and Grand Isle sites

Table 4.3 Bioaccumulation factors for diploid and triploid oysters at the Bay Jimmy and Grand Isle sites.

Date	Site	ΣPAH_{sed}	ΣPAH_{dip}	ΣPAH_{trip}	TOC (%)	$Lipids_{dip}$ (%)	$Lipids_{trip}$ (%)	BAF_{dip}	BAF_{trip}	$BASF_{dip}$	$BASF_{trip}$
072811	1	394	67.9	79.8	5.5	14.9	10.4	0.17	0.20	0.06	0.11
	2	532	94.3	110	8.1	15.1	11.6	0.18	0.21	0.09	0.14
	3	566	100	117	8.1	16.7	11.1	0.18	0.21	0.09	0.15
	4	434	73.7	86.3	5.9	14.6	10.7	0.17	0.20	0.07	0.11
	5	507	86.1	101	7.1	16.5	11.4	0.17	0.20	0.07	0.13
	6	50.9	30.5	33.5	1.4	15.5	10.6	0.60	0.66	0.06	0.09
091611	1	484	86.5	98.9	7.3	11.4	10.2	0.18	0.20	0.11	0.15
	2	660	93.5	130	8.2	12.3	9.5	0.14	0.20	0.09	0.17
	3	697	101	141	7.9	11.0	10.1	0.15	0.20	0.10	0.16
	4	530	88.0	108	7.9	11.6	11.4	0.17	0.20	0.11	0.14
	5	599	97.0	120	7.5	10.9	10.0	0.16	0.20	0.11	0.15
	6	66.7	33.4	41.3	1.8	11.6	10.9	0.50	0.62	0.08	0.10
112111	1	411	88.5	83.5	6.7	9.2	9.0	0.22	0.20	0.16	0.15
	2	559	119	112	7.8	8.8	7.9	0.21	0.20	0.19	0.20
	3	594	122	115	7.7	8.7	9.6	0.20	0.19	0.18	0.16
	4	447	95.7	91.5	6.5	8.4	9.1	0.21	0.20	0.17	0.15
	5	486	98.9	93.3	7.2	8.9	9.3	0.20	0.19	0.16	0.15
	6	57.1	36.7	34.9	1.6	8.7	8.6	0.64	0.61	0.12	0.12
022812	1	371	77.3	73.8	6.1	7.8	9.8	0.21	0.20	0.16	0.12
	2	510	107	103	6.9	8.5	10.0	0.21	0.20	0.17	0.14
	3	539	116	109	8.1	8.4	9.2	0.22	0.20	0.21	0.18
	4	404	87.3	83.2	5.7	7.9	8.3	0.22	0.21	0.16	0.14
	5	441	96.3	90.9	5.9	8.8	7.6	0.22	0.21	0.15	0.16
	6	60.9	38.6	37.3	1.8	8.8	9.0	0.63	0.61	0.13	0.12
053012	1	307	67.1	64.0	5.6	11.5	10.2	0.22	0.21	0.11	0.11
	2	387	83.7	79.1	5.9	11.2	10.0	0.22	0.20	0.11	0.12
	3	444	92.1	88.9	6.5	11.6	10.6	0.21	0.20	0.12	0.12
	4	331	70.0	66.6	4.6	11.1	10.9	0.21	0.20	0.09	0.09
	5	367	79.0	74.8	5.4	10.8	10.5	0.22	0.20	0.11	0.10
	6	59.2	37.8	36.3	1.6	11.5	9.8	0.64	0.61	0.09	0.10
082312	1	249	43.2	50.2	4.5	14.3	11.8	0.17	0.20	0.05	0.08
	2	338	58.1	67.9	5.6	15.3	11.5	0.17	0.20	0.06	0.10
	3	360	61.9	72.2	5.9	15.6	10.8	0.17	0.20	0.07	0.11
	4	269	47.7	54.7	4.0	14.8	11.7	0.18	0.20	0.05	0.07
	5	281	47.0	55.2	4.1	15.5	11.2	0.17	0.20	0.04	0.07
	6	67.3	39.8	42.7	1.9	15.7	11.1	0.59	0.64	0.07	0.11
090712	1	301	47.6	60.8	5.1	12.2	10.0	0.16	0.20	0.07	0.10
	2	407	61.8	82.1	6.7	11.3	10.0	0.15	0.20	0.09	0.13
	3	433	65.7	87.3	7.3	11.4	10.7	0.15	0.20	0.10	0.14
	4	326	50.9	65.2	4.5	11.5	9.7	0.16	0.20	0.06	0.09
	5	384	51.9	75.6	5.4	10.7	9.3	0.13	0.20	0.07	0.11
	6	64.5	31.0	39.3	1.7	10.8	10.8	0.48	0.61	0.08	0.10

(organic carbon content, grain size). Several authors have found that bioavailability of hydrophobic contaminants was greatly reduced when sediments contained high organic matter content[30, 32]. In addition, PAH bioavailability was found to be dependent on

grain-size distribution of the sediment[127]. For muddy samples, like the Bay Jimmy sites, PAHs are strongly bound to the fine sediment grains and their bioavailability is greatly reduced. The muddy sediment organic content of Bay Jimmy ranged from 4.0 to 8.2%, while the sandy sediment organic content of Grand Isle ranged from 1.4 to 1.8%. The reduced bioavailability of the PAHs leads to low bioaccumulation factors of < 0.25. The BAFs of oysters exposed to contaminated sand (avg. BAF = 0.62) where much greater than those exposed to muddy sediment. Between the ploidy, significant differences ($p<0.05$) in BAFs were observed during the spawning season (July 2011, September 2011, August 2012, and September 2012 sampling events).

Advanced methods for predicting bioaccumulation have been established based on equilibrium partitioning for establishing sediment criteria[128]. One of the mostly widely used application considers that biota contaminant concentration may be predicted from its partition between biota lipid fraction and sediment organic carbon content. The biota sediment accumulation factor (BSAF) is calculated as follows (eqn. 4.1):

$$\mathrm{BSAF} = \frac{(\mathrm{C_{oyster}/L})}{(\mathrm{C_{sed}/TOC})} \tag{4.1}$$

where C_{oyster} = oyster total PAH concentration (in µg/Kg); C_{sed} = sediment total PAH concentration (in µg/Kg); L = lipid fraction of the oyster tissue (in %); and TOC = total organic content of the sediment (in %). The BSAF is the ratio of lipid normalize oyster PAH concentration versus the TOC normalized sediment concentration. It is designed to remain constant and not to be biased by varying species, ploidy, sediment TOC, and contaminant chemical properties[35]. The BSAF calculated for the diploid oysters within

the Barataria Bay region ranged from 0.04 to 0.21, varying by a factor of 5.25. The BSAF calculated for the triploid oysters within the Barataria Bay region ranged from 0.07 to 0.20, varying by a factor of 2.86. Previous studies[30,129] have shown that the highest BSAF are associated with sediments contaminated at low levels (< 50 µg/Kg) and correspond to sediments of lower organic carbon content (0.1-1.1%). In this study, the BSAFs did not vary significantly and may have been biased by low variability of sediment classes. However, its variation range is not as broad as for BAF which indicates its potential for predicting maximum biota contaminant concentrations.

4.4 Conclusions

The sediments of Bay Jimmy are uniformly contaminated at moderate levels (< 734 µg/Kg). The silty mud composition of the Bay Jimmy sediments offer an excellent media for organic contaminants to bind. Sediment PAH concentrations measured at the Bay Jimmy sites were consistent with similar observations from the area[130]. Grand Isle sediments were contaminated at low levels (< 76 µg/Kg). The low concentrations at the Grand Isle site could be related to the grain-size characteristics (sandy) of the area or the protective jetties near the site. PAHs near the Bay Jimmy sites were positively identified (diagnostic ratios and biomarker fingerprinting) as originating from the *Deepwater Horizon* oil spill. PAHs found at the Grand Isle site originate from the incomplete combustion of organic material linked to anthropogenic sources.

The diploid and triploid oysters associated with the Bay Jimmy sites were contaminated at low levels (< 140 µg/Kg). Both ploidy exhibited a downward trend in PAH concentrations over time, but spikes in PAH levels were observed following

significant storm events. The diploid and triploid oysters associated with the Grand Isle site were contaminated at low levels (< 40 µg/Kg). These low and constant oyster tissue levels indicate an apparent baseline level which is thought to result from an equilibrium between uptake and depuration of the absorbed contaminants. Significant increases (17.2 % to 33.4%) in total PAH content within the triploid oysters were observed at the Bay Jimmy sites for the months coinciding with the spawning season (June-September) and elevated lipids levels in the diploid oysters. Different bioaccumulation behavior from the contaminated sediments was observed for the different sites. Bioavailability of hydrophobic contaminants was greatly reduced when sediments contained high organic matter content. In addition, PAH bioavailability was found to be dependent on grain-size distribution of the sediment. As mentioned in the results section, the oyster (diploid and triploid) and sediment total PAH content are positively correlated. The Pearson correlation coefficient (*r*) for the diploid and triploid versus the sediment was 0.9032 and 0.9765, respectively. This interesting correlation indicates that total PAH concentration within the triploid oysters can be accurately predicted by determining the total PAH in the surrounding sediment. The positive bivalve-sediment correlation may be valid for this specific site, so this phenomenon should be verified when investigating sites with contrasting environmental variables (e.g. PAH conc., oil type, sediment classification).

The results support the research hypothesis, indicating that triploid Eastern oysters are more effective than diploid Eastern oysters for biomonitoring PAH uptake in the summer months during long-term field exposure studies. This study has clearly shown that triploid oysters are an acceptable tool for long-term monitoring of pollutants

in water and sediment throughout the entire year. Triploids were shown to respond less to environmental and seasonal variations than diploids. Further testing should be conducted in large scale flow-through tank systems to determine real-time effects of various oils and concentration levels on the monitoring capability of triploid oysters.

REFERENCES

[1] Hill, M.K., 2010. Understanding Environmental Pollution, Cambridge University Press, 3rd edition.

[2] National Research Council. 2003. Bioavailability of Contaminants in Soils and Sediments: Processes, Tools, and Applications, National Academies Press.

[3] On Scene Coordinator Report on Deepwater Horizon Oil Spill (Report). September 2011. http://www.uscg.mil/foia/docs/dwh/fosc_dwh_report.pdf.

[4] Norse, E.A., Amos, J., (November 2010). "Impacts, Perception, and Policy Implications of the BP/Deepwater Horizon Oil and Gas Disaster". *Environmental Law Reporter* 40 (11): 11058–11073. ISSN 0046-2284.

[5] Adcroft, A., Hallberg, R., Dunne, J.P., Samuels, B.L., Galt, J.A., Barker, C.H., Payton, D., 2010. "Simulations of underwater plumes of dissolved oil in the Gulf of Mexico" (PDF). *Geophysical Research Letters* **37**: L18605. Bibcode: 2010 GeoRL.3718605A. doi: 10.1029/2010GL044689.

[6] Kingston P., 1999. Recovery of the marine environment following the *Braer* spill, Shetland. In: Proceedings of the 1999 Oil Spill Conference; Washington, DC: American Petroleum Institute, 103–109.

[7] Law R.J., Kelly C.A., Graham K.L., Woodhead R.J., 1997. Hydrocarbons and PAH in fish and shellfish from southwest Wales following the *Sea Empress* oil spill in 1996. In: Proceedings of the 1997 International Oil Spill Conference; Washington, DC:American Petroleum Institute, 205–211.

[8] Law R.J., Kelly C., Baker K., Jones J., McIntosh A.D., Moffat C.F., 2002. Toxic equivalency factors for PAH and their applicability in shellfish pollution monitoring studies. J Environ Monitor 4(3):383–388.

[9] Xia, K., Hagood, G., Childers, C., Atkins, J., Rogers, B., Ware, L., Armbrust, K., Jewell, J., Diaz, D., Gatian, N., Folmer, H., 2012. "Polycyclic Aromatic Hydrocarbons (PAHs) in Mississippi Seafood from Areas Affected by the Deepwater Horizon Oil Spill." *Environmental Science & Technology* 46.10: 5310-318.

[10] NOAA, Deepwater Horizon/BP Oil Spill: Size and Percent Coverage of Fishing Area Closures Due to BP Oil Spill. NOAA, National Marine Fisheries Service, Southeast Regional Office. 2010−06−21. (http://sero.nmfs.noaa.gov/ ClosureSizeandPercentCoverage.htm).

[11] NOAA, Commerce Secretary Gary Locke Announces Fishery Failure Determination in Gulf of Mexico. US Department of Commerce News Release Archive. (http://www.commerce.gov/news/press-releases/2010/05/24/ commerce-secretary-gary-locke-announces-fishery-failuredetermination).

[12] Wade, T.L., Sericano, J., Gardinali, P.R., Wolff, G., Chambers, L., 1998. "NOAA's 'Mussel Watch' Project: Current Use Organic Compounds in Bivalves." *Marine Pollution Bulletin* 37.1-2: 20-26.

[13] Romeo, M., Mourgaud, Y., Geffard, A., Gnassia-Barelli, M., Amiard, J.C., Budzinski, H., 2003. "Multimarker Approach in Transplanted Mussels for Evaluating Water Quality in Charentes, France, Coast Areas Exposed to Different Anthropogenic Conditions." *Environmental Toxicology* 18.5: 295-305.

[14] Stevens, J., Zhao, L., Zweigenbaum, J., 2009. Modified QuEChERS: Variant solvent systems in response to the acetonitrile shortage; Agilent Technology application poster. In 123rd AOAC international meeting, Philadelphia, PA.

[15] Dridi, S., Romdhane, M.S., Elcafsi, M., 2007. Seasonal Variation in Weight and Biochemical Composition of the Pacific Oyster, Crassostrea Gigas in Relation to the Gametogenic Cycle and Environmental Conditions of the Bizert Lagoon, Tunisia. *Aquaculture* 263.1-4: 238-48.

[16] Mitra, A., Basu, S., Banerjee, K., 2008. Seasonal variation in biochemical composition of edible oyster (*Saccostre cucullata*) from Indian sundarbans. Fishery Technology, 45.2: 209-216.

[17] Harvey, R.G., 1991. *Polycyclic Hydrocarbons: Chemistry and Carcinogencity.* Cambridge University Press, Cambridge.

[18] Hecht, S.S., Melikian, A.A., and Amin, S. 1988. Effects of the methyl susbstitution on the tumorigenicity and metabolic activation of polycyclic aromatic hydrocarbons. In *Polynuclear Aromatic Hydrocarbons Carcinogenesis: Structure-Activity Relationships* (S. K. Yang and B. D. Silverman, Eds.), Vol. 1, pp. 95–128. CRC Press, Boca Raton, FL.

[19] Douben, P., 2003. *PAHs: An Ecotoxicological Perspective*. Chichester, England: Wiley.

[20] EPA (1987) *Quality Criteria for Water 1986*. EPA 440/5-86-001. US Environmental Protection Agency, Washington, DC.

[21] Ramseur, J.L., Hagerty, C.L., (31 January 2013). Deepwater Horizon Oil Spill: Recent Activities and Ongoing Developments (Report). CRS Report for Congress. Congressional Research Service. R42942. http://www.fas.org/sgp/crs/misc/R42942.pdf.

[22] "Environmental Impact of the Deepwater Horizon Oil Spill." *Wikipedia*. Wikimedia Foundation, 25 Oct. 2014. Web. 12 Nov. 2014.

[23] Biello, D., (9 June 2010). "The BP Spill's Growing Toll On the Sea Life of the Gulf". *Yale Environment 360*. Yale School of Forestry & Environmental Studies.

[24] Schwacke, L.H., Smith, C.R., Townsend, F.I., Wells, R.S., Hart, L.B., Balmer, B.C., Collier, T.K., Guise, S.D., Fry, M.M., Guillette, Jr., L.J., Lamb, S.V., Lane, S.M., McFee, W.E., Place, N.J., Tumlin, M.C., Ylitalo, G.M., Zolman, E.S., Rowles, T.K., 2013. Health of Common Bottlenose Dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, Following the *Deepwater Horizon* Oil Spill. *Environ. Sci. Technol.*, 2014**,** *48* (1), pp 93–103.

[25]John P.I., Gardner, L.D., Linbo, T.L., Brown, T.L., Esbaugh, A.J., Mager, E.M., Stieglitz, J.D., French, B.L., Labenia, J.S., Laetz, C.A., Tagal, M., Sloan, C.A., Elizur, A., Benetti, D.B., Grosell, M., Block, B.A., Scholz, N.L., 2014. *Deepwater Horizon* crude oil impacts the developing hearts of large predatory pelagic fish. PNAS, 111: E1510-1518.

[26] Stanley, J.G., Allen, Jr., S.K., Hidu, H., 1981. Polyploidy induced in the American oyster, *Crassostrea virginica,* with cytochalasin B. *Aquaculture, 23:* l-10.

[27] Stanley, J.G., Allen, Jr., S.K., Hidu, H., 1984. Growth of American oysters increased by polploidy induced by blocking meiosis I nut not meiosis II. *Aquaculture*. 37: 147-156.

[28] The story of triploid oysters. *The Oysters My World*. 12 Apr. 2012.

[29] Downing, S.L., Allen Jr., S.K., 1987. Induced triploidy in the Pacific oyster, *Crassostrea gigas*: Optimal treatments with cytochalasin B depend on temperature. Aquaculture. 61: 1-15.

[30] Shen, Y.-P., Zhang, X.-Y., He, H.-P., Ma, L.-J., 1993. Triploidy induction by hydrostatic pressure in the pearl oyster, *Pinctada martensii* Dunker. *Aquaculture***,** 110: 221-227.

[31] Desrosiers, R.R., Gérard, A., Peignon, J.M., Naciri, Y., Dufresne, L., Morasse, J., Ledu, C., Phelipot, P., Guerrier, P., Dubé, F., 1993. A novel method to produce triploids in bivalve molluscs by the use of 6-dimethylaminopurine. *Journal of Experimental Marine Biology and Ecology* 170.1: 29-43.

[32] Guo, X., DeBrosse, G.A., Allen Jr, S.K., 1996. All-triploid Pacific oysters (Crassostrea gigas Thunberg) produced by mating tetraploids and diploids. *Aquaculture* 142.3: 149-161.

[33] 4Cs Breeding Technologies, Inc. Web. 11 November 2014. http://www.4cshellfish.com/

[34] Wade T.L., Sericano J.L., Gardinali P.R., Wolff G., Chambers L., 1998. NOAA's 'Mussel Watch' Project: Currnet use Organic Compounds in Bivalves. Mar Poll Bull 37: 20-26.

[35] Soniat, T.M., King, S.M., Tarr, M.A., Thorne, M.A. "Chemical and physiological measures on oysters (Crassostrea virginica) from oil-exposed sites in Louisiana. (Report)". *Journal of Shellfish Research*. 30.3 2011-12-01. 713(5).

[36] Meador J.P., Stein J.E., Reichert W.L., Varanasi U., 1995. Bioaccumulation of polycyclic aromatic hydrocarbons by marine organisms. Rev Environ Contam 143:79–165.

[37] Law R.J., Hellou J., 1999. Contamination of fish and shellfish following oil spill incidents. Environ Geosci 6:90–98.

[38] Hellou J., Warren W.G., Mercer G., 1995. Organochlorines in Pleuronectidae: comparison between three tissues of three species inhabiting the Northwest Atlantic. Arch Environ Contam Toxicol 29(3):302–308.

[39] Stegeman J.J., Lech J.J., 1991. Cytochrome-P-450 monooxygenase systems in aquatic species: carcinogen metabolism and biomarkers for carcinogen and pollutant exposure. Environ Health Perspect 90:101–109.

[40] Yender R., Michel J., Lord C., 2002. Managing Seafood Safety after an Oil Spill. Seattle, WA: Hazardous Materials Response Division, Office of Response and Restoration, National Oceanic and Atmospheric Administration.

[41] Michel, J., Henry C.B., 1997. "Oil Uptake and Depuration in Oysters after Use of Dispersants in Shallow Water in El Salvador." *Spill Science & Technology Bulletin* 4.2: 57-70.

[42] Baumard, P., Budzinski, H., Garrigues P., 1998. "PAHs in Arcachon Bay, France: Origin and Biomonitoring with Caged Organisms." *Marine Pollution Bulletin* 36.8: 577-86.

[43] Carmichael, R.H., Jones, A.L., Patterson, H.K, Walton, W.C., Pérez-Huerta, A., Overton, E.B., Dailey, M., Willett, K.L., 2012. "Assimilation of Oil-Derived Elements by Oysters Due to the Deepwater Horizon Oil Spill." *Environmental Science & Technology* 46.23: 12787-2795.

[44] Johnson, Y.S., 2012. "Determination of Polycyclic Aromatic Hydrocarbons in Edible Seafood by QuEChERS-Based Extraction and Gas Chromatography-Tandem Mass Spectrometry." *Journal of Food Science* 77.7: T131-137.

[45] Forsberg, N.D., Wilson, G.R., Anderson, K.A., 2011. "Determination of Parent and Substituted Polycyclic Aromatic Hydrocarbons in High-Fat Salmon Using a Modified QuEChERS Extraction, Dispersive SPE and GC–MS." *Journal of Agricultural and Food Chemistry* 59.15: 8108-116.

[46] Hansen, Charles M., 2012. *Hansen Solubility Parameters A User's Handbook, Second Edition*. Hoboken: Taylor and Francis.

[47] Hansen, Charles M., 1967. *The Three Dimensional Solubility Parameter and Solvent Diffusion Coefficient. Their Importance in Surface Coating Formalation*. Copenhagen: Danish Technical.

[48] Scott, W.C., Dean, J.R., 2003. "Selective Extraction of Persistent Organic Pollutants from Environmental Matrices." *Journal of Environmental Monitoring* 5.5: 724.

[49] Burke, J., 1984. *Solubility Parameters: Theory and Application*. S.l.: Oakland Museum of California.

[50] Manahan S.E., 1994. Environmental Chemistry. 6th ed. Boca Raton, FL: Lewis. 811 p.

[51] U.S. Food and Drug Administration. 2010. Protocol for Interpretation and Use of Sensory Testing and Analytical Chemistry Results for Re-Opening Oil-Impacted Areas Closed to Seafood Harvesting Due to the Deepwater Horizon Oil Spill. Available from http://www.fda.gov/Food/ucm217601.htm.

[52] Gratz S.R., Ciolino L.A., Mohthaus A.S., Gamble B.M., Gracie J.M., Jackson D.S., Roetting II J.P., McCauley H.A., Heitkemper D.T., Frickie F.L., Krol W.J., Arsenault T.I., White J.A., Flottmeyer M.M., Johnson Y.S., 2011. Screening and determination of polycyclic aromatic hydrocarbons in seafood using QuEChERS based extraction and high performance liquid chromatography with fluorescence detection. J AOAC Int. 94:1601-16.

[53] Sloan C.A., Anulation B.F., Bolton J.I., Boyd D., Boyer R.H., Burrows D.G., Buzitius J., Silvia D., Herman D.P., Pearce R.W., Reichert W.I., Krahn M.M., Dickoff W.W., Stein J.E., Ylitalo G.M., 2010. Extraction, cleanup, and gas chromatography/mass spectrometry analysis of edible seafood for parent and alkyl polycyclic aromatic hydrocarbons in response to the Deepwater Horizon MC252 oil spill event. Seattle, WA. National Oceanic and Atmospheric Administration (NOAA).

[54] United States Environmental Protection Agency (U.S. EPA). *Method 3540C, Soxhlet Extraction*; U.S. EPA: Washington DC, 1996.

[55] Richter B.E.; et al. 1996. Accelerated solvent extraction: A technique for sample preparation. Anal. Chem. 68: 1033-1039.

[56] Johnson Y.S., 2012. Determination of polycyclic aromatic hydrocarbons in edible seafood by QuEChERS-based extraction and gas chromatography-tandem mass spectrometry. J of Food Science. 77: 131-37.

[57] Lehotay S.J., Mastovska K., Yun S.J., 2005. Evaluation of two fast and easy methods for pesticide residue analysis in fatty food matrixes. J AOAC Int. 94:1601-16.

[58]Smoker M., Tran K., Smith R.E., 2010. Determination of polycyclic aromatic hydrocarbons (PAHs) in shrimp. J Agric Food Chem. 58: 12101-12104.

[59] João Ramalhosa M.: et al. 2009. Analysis of polycyclic aromatic hydrocarbons in fish: evaluation of a quick, easy, cheap, effective, rugged, and safe extraction method. J Sep Sci. 32: 3529-3538.

[60] Forsberg N.D., Wilson G.R., Anderson K.A., 2011. Determination of parent and substituted polycyclic aromatic hydrocarbons in high-fat salmon using a modified QuEChERS extraction, dispersive SPE and GC-MS. J Agric Food Chem. 59: 8108-16.

[61] Angioni A., Porcu L., Seeei M., Addis P., 2012. QuEChERS method for the determination of PAH compounds in Sadinia sea urchins (*Paracentrotus lividus*) roe, using gas chromatography ITMS-MS analysis. Food Anal Methods. 5: 1131-1136.

[62] Dickey R.W., 2012. FDA risk assessment of seafood contamination after the BP oil spill [Letter]. Environ Health Perspect 120:A54–A55; doi: 10.1289/ehp.1104539.

[63] Baird S.J., Bailey E.A., Vorhees D.J., 2007. Evaluating human risk from exposure to alkylated PAHs in an aquatic system. Hum Ecol Risk Assess 13:322–338.

[64] Hansen C.M., 2007. Hansen solubility parameters – A user's guide. Boca Raton, Florida: CRC Press, Inc.

[65] Smedes, F., 1999. Determination of total lipid using non-chlorinated solvents. National Institute for Coastal and Marine Management, Netherlands. Paper 9/05904K.

[66] Lehotay S.J., Son K.A., Kwon H., Koesukwiwat U., Fu W., Mastovska K., Hoh E., Leepipatpiboon N., 2010. Comparison of QuEChERS sample preparation methods for the analysis of pesticide residues in fruits and vegetables. J Chromo A. 1217: 2548-2560.

[67] Lehotay, S.J., Mastovska K., Lightfield A.R., Gates R.A., 2010. Multi-analyst, multi-matrix performance of the QuEChERS approach for pesticide residues in foods and feeds using HPLC/MS/MS analysis with different calibration techniques. J AOAC Int. 93: 355-367.

[68] U.S Code of Federal Regulations. Title 40-Protection of Environment, Part 136 Appendix B-Definition and Procedure for the Determination of the Method Detection Limit. Available from http://ecfr.gpoaccess.gov/.

[69] Navarro P., Etxebarria N., Arana G., 2009. Development of a focused ultrasonic-assisted extraction of polycyclic aromatic hydrocarbons in marine sediment and mussel samples. Ana Chim Acta. 648: 178-182.

[70] Mastovska K., Lehotay S., 2004. Evaluation of common organic solvents for gas chromatographic analysis and stability of multiclass pesticide residues. J Chromo A. 1040: 259-272.

[71] Anastassides M., Lehotay S.J., Stajnbaher D., Schenck F.J., 2003. Fast and easy multiresidue method employing acetonitrile extraction/partitioning and dispersive solid-phase extraction for the determination of pesticide residues in produce. J AOAC Int. 86: 412-431.

[72] Richter B.E., et al., 1996. Accelerated solvent extraction: A technique for sample preparation. Anal Chem. 68: 1033-1039.

[73] Wang G., et al. 1999. Accelerated solvent extraction and gas chromatography/mass spectrometry for determination of polycyclic aromatic hydrocarbons in smoked food samples. J Agric Food Chem. 47: 1062-1066.

[74] Afolabi O.A., Adesul E.A., and Oke O.L., 1983. Polynuclear aromatic hydrocarbons in some Nigerian preserved freshwater fish species. J Agric Food Chem. 31: 1083-1090.

[75] Gunther, A.J., Davis, J.A., Hardin, D.D., Gold, J., Bell, D., Crick, J.R., Scelfo, G.M., Sericano, J., Stephenson, M., 1999. Long-term bioaccumulation monitoring with transplanted bivalves in the San Francisco estuary. Marine Pollution Bulletin. 3: 170-181.

[76] Safahieh, A.R., Mahmoudi M., Nikpour Y., Ghanemi K., 2011. Evaluation of Ark clam (Barbatia helblingii) as Biomonitor Agent for PAHs Contamination in Coastal Area of Bushehr. Journal of Env. Studies. 37: 40-42.

[77] Meader, J.P., Stein, J.E., Reichert, W.L., Varanasi, U., 1995. Bioaccumulation of Polycyclic Aromatic Hydrocarbons by Marine Organisms. Reviews of Environmental Contamination and Toxicology. 143: 79-165.

[78] Hwang, H., Stanton, B., McBride, T., Anderson, M.J., 2014. Polycyclic aromatic hydrocarbon body residues and lysosomal membrane destabilization in mussels exposed to the *Dubai Star* bunker fuel oil (Intermediate fuel oil 380) spill in San Francisco Bay. Environmental Toxicology and Chemistry. 33: 1117-21.

[79] Guéguen, M., Baron, R., Bardouil, M., Haberkorn, H., Soudant, P., Truquet, P., Lassus, P., 2012. Influence of *Crassostrea gigas* (Thunberg) sexual maturation stage and ploidy on uptake of paralytic phycotoxins. Toxicon. 60: 40-43.

[80] Kesarcodi-Watson, A., Klumpp, D.W., Lewis, J.S., 2001. Comparative feeding and physiological energetics in diploid and triploid Sydney rock oysters (*Saccostrea commercialis*): II. Influences of food concentration and tissue energy distribution. Aquaculture. 1-2: 195-216.

[81] Piccardo, M.T., Coradeghini, R., Valerio, F., 2001. Polycyclic aromatic hydrocarbon pollution in native and caged mussels. Marine Pollution Bulletin. 42: 951-956.

[82] Bruner, K.A., Fisher, S.W., Landrum, P.F., 1994. The role of the zebra mussel, *Dreissena polymorpha*, in contaminant cycling: I the effect of body size and lipid content on the bioconcentration of PCBs and PAHs. Journal of Great Lakes Research. 20: 725-734.

[83] Webster, L., Angus, L., Topping, G., Dalgarno, E.J., Moffat, C.F., 1997. Long-term monitoring of polycyclic aromatic hydrocarbons in mussels (*Mytilus edulis*) following the *Braer* oil spill. Analyst. 122: 1491-1495.

[84] McIntosh, A.D., Moffat, C.F., Parker, G., Webster, L., 2003. Polycyclic aromatic hydrocarbon (PAH) concentration and composition determined in farmed blue mussels (*Mytilus edulis*) in a sea loch pre- and post-closure of an aluminum smelter. Journal of Environmental Monitoring. 6: 209-218.

[85] BP Exploration & Production Inc. and BP Gulf Coast Restoration Organization. 2014. Data Publication Summary Report: Reference Oil Characterization. Reference No. O-04v01-02. https://www.piersystem.com/go/doc/6145/1944578/Oil.

[86] Ragone Calvo, L., Burreson, E.M., 2003. Status of the major oyster diseases in Virginia—2002. A summary of the annual monitoring program. Virginia Institute of Marine Science Marine Resource Report.

[87] Pesticide Residues in Foods by Acetonitrile Extraction and Partitioning with Magnesium Sulfate. (AOAC Official Method 2007.01.).

[88] Crosby, M.P., Gale, L.D., 1990. A review and evaluation of bivalve condition index methodologies with a suggested standard method. J Shellfish Res 9, 233-237.

[89] Li, Q., Osada, M., Mori, K., 2000. Seasonal biochemical variations in Pacific oyster gonadal tissue during sexual maturation. Fisheries Science. 66: 502-508.

[90] Smedes, F., 1999. Determination of total lipid using non-chlorinated solvents. *Analyst*. 124:1711-1718.

[91] Duchemin, M.B., Fournier, M., Auffret, M., 2007. Seasonal variations of immune parameters in diploid and triploid pacific oysters, *Crassostrea gigas* (Thunberg). Aquaculture. 264: 73-81.

[92] Namiesnik, J., Moncheva, S., Park, Y., Ham, K., Heo, B., Tashma, Z., Katrich, E., Gorinstein, S., 2008. Concentration of bioactive compounds in mussels *Mytilus galloprovincialis* as an indicator of pollution. Chemosphere. 73: 938-944.

[93] Porte, C., Albaiges, J., 1993. Bioaccumulation patterns of hydrocarbons and polychlorinated biphenyls in bivalves, crustaceans, and fishes. Archives of Environmental Contamination and Toxicology. 26: 273-281.

[94] Yesudhason, P., Al-Busaidi, M., AK Al-Rahbi, W., Al-Waili, A., Al-Nakhaili, A., Al-Mazrooei, N., Al-Habsi, S., 2013. Distribution patterns of toxic metals in the marine oyster *Saccostrea cucullata* from the Arabian Sea in Oman: spatial, temporal, and size variations. Springerplus. 3: 282.

[95] Leon, V.M., Moreno-Gonzalez, R., Gonzalez, E., Martinez, F., Garcia, V., Campillo, J.A., 2013. Interspecific comparison of polycyclic aromatic hydrocarbons and persistent organochlorines bioaccumulation in bivalves from a Mediterranean coastal lagoon. Science of Total Environment. 463-464: 975-987.

[96] Tronczy´nskia J., Munschy C., Héas-Moisan K., Guiot N., Truquet I., Olivier N., Men S., Furaut A., 2004. Contamination of the Bay of Biscay by polycyclic aromatic hydrocarbons (PAHs) following the T/V “Erika” oil spill. Aquat. Living Resour. 17: 243–259.

[97] McElroy A.E., Farrington J.W., Teal J.M., 1989, Bioavailability of polycyclic aromatic hydrocarbons in the aquatic environment. In: Metabolism of polycyclic aromatic hydrocarbons in the aquatic environment. Varanasi U, CRC Press, pp. 1-39.

[98] "Deepwater Horizon." *Wikipedia*. Wikimedia Foundation, 11 Nov. 2014. Web. 12 Nov. 2014.

[99] Ramseur, J.L., Hagerty, C.L., (31 January 2013). Deepwater Horizon Oil Spill: Recent Activities and Ongoing Developments (Report). CRS Report for Congress. Congressional Research Service. R42942. http://www.fas.org/sgp/crs/misc/R42942.pdf.

[100] Karcher, W., 1988. Special Atlas of Polycyclic Aromatic Compounds, vol. 2. Kluwer Academic Publishers, Dordrecht, The Netherlands.

[101] Knezovick, J.P., Haarrion, F.L., Wilhelm, R.G., 1987. The bioavailability of sediment-sorbed of organic chemicals: a review. Water, Air and Soil Pollution. 32: 233-245.

[102] Djomo, J.E., Garrigues, P., Narbonne, J.F., 1996. Uptake and depuration of polycyclic aromatic hydrocarbons from sediments by the zebrafish (*Bracydanio rerio*). Environmental Toxicology and Chemistry, 15: 1177-1181.

[103] Harkey, G.A., Hoof, P.L., Landrum, P.F., 1995. Bioavailability of polycyclic aromatic hydrocarbons from a historically contaminated sediment core. Environmental Toxicology and Chemistry, 14: 1551-1560.

[104] Murray, A.P., Richardson, B.J., Gibbs, C.F., 1991. Bioconcentration factors for petroleum hydrocarbons, PAHs, LABs, and biogenic hydrocarbons in blue mussel. Marine Pollution Bulletin. 22: 595-603.

[105] Foster, G.D., Baski, S.M., Means, J.C., 1987. Bioaccumulation of trace organic contaminants from sediment by Batic clams (*Macoma balthica*) and soft-shell clams (*Mya arenaria*). Environmental Toxicology and Chemistry, 6: 969-976.

[106]Harkey, G.A., Hoof, P.L., Landrum, P.F., 1994. Feeding selectivity and assimilation of PAH and PCB in Diporeia spp. Environmental Toxicology and Chemistry, 13: 1445-1455.

[107] Wang, M., Nim, C., Son, S., Shi, W., 2012. Characterization of turbidity in Florida's Lake Okeechobee and Caloosahatchee and St. Lucie estuaries using MODIS_Aqua measurements. Water Res. 46: 5410-5422.

[108] U.S. Army Corps of Engineers, New Orleans District. 2013. Integrated draft feasibility report and environmental impact statement. www.mvn.usace.army.mil/.../WSision.

[109] Baumard, P., Budzinski, H., Garrigues, P., 1998. Polycyclic aromatic hydrocarbons in sediemnts and mussels of the western Mediterranean sea. Environmental Toxicology and Chemistry, 17: 765-776.

[110] Phillips, D.J.H., 1990. Use of macroalgae and invertebrates as monitors of metal levels in estuaries and coastal waters. Heavy metals in the marine environment. CRC Press, Florida. 81-99.

[111] Boyden, C.R., Phillips, D.J.H., 1981. Seasonal variation and inherent variability of trace elements in oysters and their implications for indicator studies. Mar. Ecol Prog Ser. 5: 29-40.

[112] Joiris, C.R., Holsbeek, L., Otchere, F.A., 2000. Mercury in the bivalves *Crassotrea tulipa* and *Pema pema* from Ghana. Mar Pollut Bull. 38: 618-622.

[113] Farrington, J.W., Goldberg, E.D., Risegrough, R.W., Martin, J.H., Bowen, V.T., 1983. US 'Mussel Watch' 1976-1978: An overview of the trace-metal, DDE, PCB, hydrocarbons, and artificial radionuclide data. Environ. Sci. Technol. 17: 490-496.

[114] Baumard, P., Budzinski, H., Garrigues, P., 1998. PAHs in Arcachon Bay, France: Origin and biomonitoring with caged organisms. Marine Pollution Bulletin. 36, 8: 577-586.

[115] Mersch, J., Wagner, P., Pihan, J.C., 1996. Copper in indigenous and transplanted zebra mussels in relationship to changing water concentrations and body weight. Environmental Toxicology and Chemistry, 15: 886-893.

[116] Webster, L., Russell, M., Walsham, P., Phillips, L.A., Packer, G., Scurfield, J.A., Dalgamo, E.J., Moffat, C.F., 2008. Long term monitoring of persistent organic pollutants (POPS) in wild and rope grown blue mussels (*Mytilius edulis*) from Scottish coastal waters. Fisheries Research Services internal report No. 28/08.

[117] Zengel, S., Michel, J., 2013. *Deepwater Horizon* Oil Spill: Salt Marsh Oiling Conditions, Treatment Testing, and Treatment History in Northern Barataria Bay, Louisiana (Interim Report October 2011). *U.S. Dept. of Commerce, NOAA Technical Memorandum NOS OR&R 42*. Seattle, WA: Emergency Response Division, NOAA. 74 pp. http://response.restoration.noaa.gov/deepwater_horizon.

[118] Chesapeake Bay Oyster Company. 2009. Web. 11 November 2014. < http://www.bayoyster.com/oysters.html>

[119] Smedes, F., 1999. Determination of total lipid using non-chlorinated solvents. *Analyst*. 124:1711-1718.

[120] United States Environmental Protection Agency. 2007. SW-846 Method 3550C: Ultrasonic Extraction. Retrieved from the Environmental Protection Agency website: http://www.epa.gov/wastes/hazard/testmethods/sw846/pdfs/3550c.pdf.

[121] Nowell, L.H., Ludtke, A.S., Mueller, D.K., Scott, J.C., 2013. Organic contaminants, trace and major elements, and nutrients in water and sediment sampled in response to the Deepwater Horizon oil spill: U.S. Geological Survey Open-File Report 2012–5228, 96 p, plus appendixes.

[122] Landrum, P.F., Robbins, J.A., 1990. Bioavailability of sediment-associated contaminants to benthic invertebrates. In Sediments: Chemistry and toxicity of in-place pollutants, Chapter 8. Lewis Publishers, Michigan. 237-263.

[123] Neff, J.M., 1979. In: Polycyclic aromatic hydrocarbons in the aquatic environment. Sources, fates, and biological effects. Applied Science Publishers, London. 1-262.

[124] Baumard, P., Budzinski, H., Garrigues, P., Dizer, H., Hansen, P.D., 1999. Polycyclic aromatic hydrocarbons in recent sediments and mussels (Mytilus edulis) from the Western Baltic Sea: occurrence, bioavailability and seasonal variations. Marine environmental research. 47: 17-47.

[125] Benlahcen, K.T., Chaoui, A., Budzinski, H., Garrigues, P., 1997. Distribution and sources of polycyclic aromatic hydrocarbons in some Mediterranean coastal sediment. Mar Pollut Bull 34:298–305.

[126] Gagnaire, B., Soletchnik, P., Madec, P., Geairon, P., Le Moine, O., Renault, T., 2006. Diploid and triploid Pacicific oysters, *Crassostrea gigas* (Thunberg), reared at two heights above sediment in Marennas-Oleron Basin, France: Difference in mortality, sexual maturation and hemocyte parameters. Aquaculture. 254, 1-4: 606-616.

[127] Harkey, G.A., Hoof, P.L., Landrum, P.F., 1994. Feeding selectivity and assimilation of PAH and PCB in *Diporeia* spp. Environmental Toxicology and Chemistry. 13: 1445-1455.

[128] Di Toro, D.M., Zarba, C.S., Hansen, D.J., Berry, W.J., Swartz, R.C., Cowan, C.E., Pavlou, S.P., Allen, H.E., Thomas, N.A., Paquin, P.R., 1991. Technical basis for establishing sediment quality criteria for nonionic organic chemicals using equilibrium partitioning. Environmental toxicology and Chemistry. 10: 1541-1583.

[129] Lake, J.L., Rubinstein, N.I., Lee, H., Lake, C.A., Heltshe, J.H., Pavingnano, S., 1990. Equilibrium partitioning and bioaccumulation of sediment-associated contaminants by infaunal organisms. Environmental toxicology and Chemistry. 9: 1095-1106.

[130] Silliman, B. R., Van De Koppel, J., Mccoy, M.W., Diller, J., Kasozi, G.N., Earl, K., Adams, P.N., Zimmerman, A.R., 2012. Degradation and Resilience in Louisiana Salt Marshes after the BP-Deepwater Horizon Oil Spill. *Proceedings of the National Academy of Sciences* 109.28: 11234-1239.

APPENDIX

Table A.1. Summary of the PAH (ng/g, dry wt) recoveries, std. deviation, and %RSD for preliminary efficacy study.

	Solvent ID																	
	1						2						3					
	40% MEK 60% TOL						50% MEK 50% CH						60% DCM 40% CH					
PAH	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD
Naphthalene	93.2	85.7	85.7	88.2	4.30	4.88	86.9	77.4	80.9	81.7	4.84	5.92	80.2	75.4	69.8	75.1	5.22	6.95
Benzothiophene	90.0	74.7	83.7	82.8	7.69	9.29	79.9	67.1	66.3	71.1	7.62	10.7	74.2	67.5	66.8	69.5	4.09	5.88
2-methylnaphthalene	92.6	85.2	80.6	86.2	6.08	7.05	85.9	80.7	80.7	82.4	2.97	3.61	79.3	75.3	69.8	74.8	4.78	6.39
1-methylnaphthalene-d10 SS#1	79.2	68.9	70.5	72.9	5.55	7.61	75.2	69.2	65.5	70.0	4.93	7.05	52.7	45.3	43.2	47.1	4.98	10.6
Biphenyl	65.1	60.6	52.8	59.5	6.26	10.5	83.9	68.0	74.7	75.5	8.00	10.6	52.6	46.3	47.9	48.9	3.29	6.72
2-ethylnaphthalene	80.9	74.4	71.2	75.5	4.94	6.55	72.2	66.5	61.4	66.7	5.42	8.13	59.1	55.6	47.3	54.0	6.07	11.2
Acenaphthylene	92.1	77.4	75.5	81.7	9.09	11.1	74.2	63.8	59.3	65.8	7.61	11.6	65.9	58.7	56.7	60.4	4.86	8.04
Acenaphthene	80.2	68.2	72.2	73.5	6.13	8.33	69.0	59.3	58.0	62.1	6.01	9.69	63.9	56.9	59.4	60.1	3.56	5.92
Dibenzofuran-d8 SS#2	66.2	57.0	60.3	61.2	4.70	7.68	58.0	51.7	54.6	54.8	3.20	5.84	61.2	56.3	56.3	57.9	2.83	4.88
Dibenzofuran	99.3	83.4	91.4	91.4	7.94	8.70	86.9	72.1	77.3	78.8	7.49	9.51	91.2	80.3	80.3	83.9	6.32	7.53
Fluorene	63.5	55.8	55.2	58.2	4.59	7.89	55.3	47.5	48.1	50.3	4.32	8.58	73.2	64.5	62.3	66.7	5.81	8.72
Dibenzothiophene	53.5	50.3	46.5	50.1	3.48	6.95	64.1	53.2	53.9	57.1	6.12	10.7	64.3	57.8	54.6	58.9	4.91	8.33
Phenanthrene	95.6	88.0	88.0	90.5	4.42	4.88	88.3	83.9	83.9	85.4	2.55	2.99	84.9	74.7	67.9	75.8	8.55	11.3
Anthracene-d10 SS#3	49.6	45.1	46.1	46.9	2.34	4.99	50.5	45.9	44.9	47.1	2.96	6.28	52.0	45.3	42.7	46.6	4.83	10.4
Anthracene	64.1	53.2	53.8	57.0	6.11	10.7	85.2	69.0	81.0	78.4	8.39	10.7	61.0	51.3	54.9	55.7	4.93	8.85
Carbozole	68.9	63.4	63.4	65.2	3.18	4.88	86.2	71.5	70.7	76.1	8.72	11.5	59.9	50.9	47.9	52.9	6.24	11.8
4-methylbenzothiophene	59.2	55.1	47.4	53.9	6.01	11.2	68.4	58.2	56.8	61.1	6.36	10.4	33.6	29.9	27.9	30.5	2.90	9.51
2-methylphenanthrene	99.9	87.9	82.9	90.3	8.73	9.67	74.4	62.5	70.7	69.2	6.09	8.80	51.6	46.5	47.0	48.4	2.84	5.88
2-methylanthracene	93.2	82.1	81.1	85.5	6.75	7.89	76.6	62.8	63.6	67.7	7.75	11.5	50.4	43.8	43.8	46.0	3.78	8.22
1-methylphenanthrene	62.7	57.1	52.7	57.5	5.03	8.75	56.1	47.7	45.4	49.7	5.62	11.3	46.5	41.9	43.3	43.9	2.39	5.44
3,6-dimethylphenanthrene	92.7	76.9	86.2	85.3	7.92	9.29	97.7	91.9	89.9	93.2	4.07	4.37	71.5	59.4	61.5	64.1	6.49	10.1
Fluoranthene	71.6	61.5	63.0	65.4	5.42	8.29	74.9	70.4	63.7	69.7	5.65	8.12	55.8	45.7	48.5	50.0	5.18	10.4
Pyrene	96.6	90.8	81.2	89.6	7.81	8.72	93.5	77.6	86.1	85.7	7.96	9.28	89.0	73.9	73.0	78.7	9.01	11.5
Benzo (a) fluorene	57.0	49.6	53.0	53.2	3.71	6.97	55.2	45.3	44.7	48.4	5.90	12.2	36.8	33.9	29.4	33.4	3.70	11.1
1-methylpyrene	99.5	86.5	92.5	92.8	6.47	6.97	80.9	70.4	74.4	75.2	5.30	7.05	82.2	67.4	75.7	75.1	7.42	9.87
Benzo (a) anthracene - d12 SS#	96.3	80.0	78.0	84.8	10.1	11.9	87.0	81.8	76.6	81.8	5.22	6.38	84.7	80.4	70.3	78.5	7.40	9.43
Benzo (a) anthracene	86.4	77.8	71.7	78.6	7.38	9.39	97.1	92.3	85.5	91.6	5.85	6.39	75.6	66.5	63.5	68.5	6.29	9.18
Chrysene	92.9	87.3	83.6	87.9	4.67	5.32	88.9	71.1	81.8	80.6	8.95	11.1	70.0	65.8	62.3	66.0	3.85	5.84
5-methylchrysene	72.6	67.5	67.5	69.2	2.93	4.24	68.7	61.1	57.7	62.5	5.62	8.99	81.8	74.4	66.2	74.1	7.77	10.5
Benzo (b) fluoranthene	41.0	38.6	33.2	37.6	3.99	10.6	60.5	53.2	50.2	54.7	5.29	9.67	64.3	54.7	52.1	57.0	6.44	11.3
Benzo (k) fluoranthene	73.5	67.6	65.4	68.8	4.18	6.07	96.0	82.5	86.4	88.3	6.92	7.84	83.5	73.5	69.3	75.4	7.30	9.67
Benzo (e) pyrene	91.8	80.8	73.4	82.0	9.24	11.27	86.4	80.3	75.1	80.6	5.62	6.97	73.6	64.1	70.0	69.2	4.83	6.98
Benzo (a) pyrene - d12 SS#5	83.7	72.8	74.5	77.0	5.86	7.61	73.7	67.8	61.2	67.6	6.27	9.28	99.1	91.2	90.2	93.5	4.89	5.23
Benzo (a) Pyrene	82.1	68.2	70.6	73.6	7.45	10.1	54.9	47.8	47.3	50.0	4.29	8.58	65.4	55.6	54.9	58.7	5.86	10.0
Perylene	62.4	54.3	54.9	57.2	4.51	7.89	64.2	61.0	57.1	60.8	3.54	5.82	49.4	46.9	43.0	46.4	3.24	6.98
Indeno (1,2,3 - cd) pyrene	82.9	78.8	74.6	78.8	4.15	5.26	76.8	69.9	65.3	70.6	5.80	8.21	82.5	67.7	72.6	74.3	7.56	10.2
Dibenzo (a,h) anthracene	73.4	67.6	59.5	66.8	7.01	10.5	69.1	61.5	63.6	64.7	3.93	6.07	58.9	53.0	47.7	53.2	5.60	10.5
Benzo (g,h,i) perylene	73.0	63.5	65.0	67.2	5.11	7.61	74.8	64.3	68.1	69.1	5.31	7.68	79.3	70.6	65.8	71.9	6.84	9.51
Avg. total PAH recovery (%)				72.2						69.6						61.7		

Table A.1. Summary of the PAH (ng/g, dry wt) recoveries, std. deviation, and %RSD for preliminary efficacy study (continued).

PAH	Solvent ID																	
	4						5						6					
	40% ACE 60% CH						50% MEK 40% CH 10% TOL						30% ACE 30% MEK 40% CH					
	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD
Naphthalene	70.2	59.2	61.1	63.5	5.89	9.28	81.2	78.8	70.6	70.2	5.53	7.87	90.0	87.3	78.3	85.2	6.13	7.19
Benzothiophene	81.2	64.9	67.4	71.2	8.79	12.3	91.2	85.7	86.6	80.2	2.93	3.65	83.8	77.9	88.9	83.5	5.50	6.58
2-methylnaphthalene	75.6	64.6	62.7	67.6	6.95	10.3	85.0	85.0	86.7	75.4	0.98	1.30	88.4	92.0	86.1	88.8	2.95	3.32
1-methylnaphthalene-d10 SS#1	72.6	56.0	61.7	63.4	8.42	13.3	80.0	73.6	90.4	81.3	8.48	10.4	99.8	89.8	91.6	93.7	5.35	5.70
Biphenyl	76.1	59.5	68.5	68.0	8.30	12.2	72.0	68.4	66.2	68.9	2.91	4.22	97.0	102	92.8	97.2	4.51	4.64
2-ethylnaphthalene	69.5	57.3	55.6	60.8	7.58	12.5	76.0	69.9	78.3	74.7	4.32	5.78	81.3	74.8	86.2	80.8	5.71	7.07
Acenaphthylene	81.9	60.9	68.0	70.3	10.7	15.2	80.0	76.8	91.2	82.7	7.56	9.15	94.8	90.0	92.8	92.5	2.38	2.57
Acenaphthene	71.9	63.9	61.1	65.6	5.60	8.54	81.7	73.5	95.6	83.6	11.15	13.3	88.5	80.5	103	90.5	11.2	12.4
Dibenzofuran-d8 SS#2	69.2	67.2	62.3	66.2	3.57	5.38	93.6	88.0	110.5	83.6	11.69	14.0	85.6	84.7	95.9	88.7	6.19	6.98
Dibenzofuran	86.7	68.7	78.0	77.8	9.02	11.6	84.6	76.1	88.5	83.1	6.32	7.61	97.3	90.5	91.9	93.3	3.60	3.86
Fluorene	71.4	69.9	57.8	66.4	7.43	11.2	88.0	81.0	103.8	90.9	11.72	12.9	82.0	81.2	83.6	82.3	1.25	1.52
Dibenzothiophene	83.7	75.3	69.5	76.2	7.15	9.39	87.0	82.7	82.7	84.1	2.51	2.99	87.7	82.4	86.8	85.7	2.82	3.29
Phenanthrene	68.6	73.1	59.0	66.9	7.20	10.8	91.8	86.3	91.8	81.8	3.18	3.89	98.4	94.5	101	98.1	3.46	3.52
Anthracene-d10 SS#3	79.5	64.8	64.4	69.6	8.61	12.4	81.0	73.7	91.5	82.1	8.96	10.9	89.9	89.0	91.7	90.2	1.37	1.52
Anthracene	86.9	66.5	76.5	76.6	10.2	13.3	82.0	75.4	89.4	82.3	6.97	8.48	83.9	83.1	88.9	85.3	3.18	3.72
Carbozole	77.4	68.3	64.2	70.0	6.74	9.64	72.0	66.2	69.1	69.1	2.88	4.17	81.6	78.3	79.2	79.7	1.70	2.13
4-methylbenzothiophene	80.4	65.1	64.3	69.9	9.07	13.0	89.7	87.0	82.6	86.4	3.63	4.20	82.2	78.9	80.6	80.6	1.64	2.04
2-methylphenanthrene	79.6	61.5	64.5	68.5	9.70	14.2	86.6	78.0	78.0	80.8	5.00	6.19	98.5	90.7	88.3	92.5	5.36	5.80
2-methylanthracene	77.4	64.6	62.7	68.2	8.00	11.7	89.5	86.8	104.8	79.5	9.66	12.1	97.0	94.1	92.1	94.4	2.44	2.59
1-methylphenanthrene	70.9	54.6	62.4	62.6	8.13	13.0	81.0	73.7	95.5	83.4	11.13	13.3	81.6	76.7	86.5	81.6	4.90	6.00
3,6-dimethylphenanthrene	79.8	68.9	66.2	71.6	7.19	10.0	76.0	75.2	86.6	79.3	6.37	8.04	96.2	87.6	99.4	94.4	6.12	6.49
Fluoranthene	77.4	59.6	65.8	67.6	9.05	13.4	72.0	67.0	79.9	73.0	6.53	8.95	93.7	89.0	94.7	92.5	3.01	3.26
Pyrene	86.8	73.9	72.9	77.9	7.75	10.0	83.0	79.7	85.5	82.7	2.91	3.52	80.4	78.8	88.5	82.6	5.17	6.26
Benzo (a) fluorene	80.8	62.8	69.5	71.0	9.08	12.8	86.1	82.6	98.2	76.1	8.18	10.8	75.9	68.3	88.0	77.4	9.95	12.9
1-methylpyrene	91.7	68.3	80.7	80.2	11.7	14.6	94.4	94.4	86.7	91.9	4.47	4.87	88.4	91.1	94.6	91.4	3.11	3.40
Benzo (a) anthracene - d12 SS#	64.2	81.3	56.5	67.3	12.7	18.9	93.3	86.7	94.2	91.4	4.06	4.45	96.3	97.2	93.4	95.6	2.00	2.10
Benzo (a) anthracene	52.3	63.3	42.9	52.8	10.2	19.3	87.6	84.1	82.4	77.2	2.68	3.47	80.2	77.0	73.0	76.7	3.62	4.71
Chrysene	66.9	63.6	54.9	61.8	6.22	10.1	78.9	71.8	74.2	74.9	3.62	4.82	97.9	94.0	91.0	94.3	3.44	3.65
5-methylchrysene	70.1	59.7	62.4	64.1	5.40	8.43	87.0	78.3	88.7	84.6	5.59	6.61	85.5	78.6	82.1	82.1	3.42	4.17
Benzo (b) fluoranthene	69.7	61.8	62.7	64.7	4.33	6.68	83.1	83.1	93.9	73.5	6.24	8.49	69.8	70.5	72.6	71.0	1.45	2.05
Benzo (k) fluoranthene	58.1	67.5	50.0	58.5	8.79	15.0	95.1	87.5	89.4	90.7	3.96	4.37	89.1	82.8	92.5	88.1	4.90	5.55
Benzo (e) pyrene	66.5	63.1	54.5	61.4	6.16	10.0	79.3	77.7	88.0	69.3	5.55	8.01	88.1	79.3	98.7	88.7	9.71	10.9
Benzo (a) pyrene - d12 SS#5	50.5	59.3	40.4	50.1	9.47	18.9	75.9	68.3	77.4	65.9	4.88	7.40	76.6	78.9	74.3	76.6	2.30	3.00
Benzo (a) Pyrene	60.3	51.6	53.1	55.0	4.67	8.50	69.6	64.0	72.3	68.6	4.25	6.19	68.4	66.3	78.6	71.1	6.59	9.27
Perylene	70.4	62.7	60.5	64.5	5.19	8.04	70.5	67.0	83.9	73.8	8.93	12.1	69.2	69.2	64.4	67.6	2.80	4.14
Indeno (1,2,3 - cd) pyrene	66.8	57.6	58.1	60.8	5.17	8.49	76.1	68.5	79.1	66.1	5.49	8.30	71.3	71.3	84.8	75.8	7.82	10.3
Dibenzo (a,h) anthracene	62.8	53.5	51.5	55.9	6.02	10.8	70.3	66.1	68.2	60.3	2.11	3.50	70.5	69.1	64.9	68.2	2.94	4.31
Benzo (g,h,i) perylene	58.4	52.0	52.0	54.1	3.69	6.82	70.7	65.0	71.4	56.7	3.49	6.15	71.3	73.4	75.6	73.4	2.14	2.91
Avg. total PAH recovery (%)				66.0						77.9						85.1		

Table A.1. Summary of the PAH (ng/g, dry wt) recoveries, std. deviation, and %RSD for preliminary efficacy study (continued).

PAH	Solvent ID																	
	7						8						9					
	20% MeCN 30% DCM 50% CH						30% MeCN 30% TOL 40% CH						40% ACE 40% EA 20% ISO					
	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD
Naphthalene	71.9	80.8	80.0	77.6	4.90	6.32	59.5	55.9	55.9	57.1	2.06	3.61	68.0	82.9	78.3	76.4	7.64	10.0
Benzothiophene	58.9	64.7	79.7	67.8	10.7	15.8	72.6	65.3	68.2	68.7	3.65	5.32	82.4	94.7	81.4	86.2	7.41	8.60
2-methylnaphthalene	67.0	72.0	74.4	71.1	3.80	5.34	51.4	50.9	48.3	50.2	1.65	3.29	58.5	70.5	75.0	68.0	8.52	12.5
1-methylnaphthalene-d10 SS#1	62.8	70.6	85.0	72.8	11.3	15.5	69.7	62.7	60.6	64.4	4.74	7.37	74.5	83.7	81.9	80.0	4.89	6.1
Biphenyl	71.9	80.8	79.9	77.5	4.90	6.32	71.6	68.7	63.7	68.0	3.99	5.86	70.8	86.4	87.9	81.7	9.46	11.6
2-ethylnaphthalene	65.7	73.9	88.1	75.9	11.3	14.9	88.9	80.0	70.2	79.7	9.33	11.7	54.6	65.0	74.1	64.6	9.76	15.1
Acenaphthylene	72.6	70.4	90.5	77.8	11.0	14.2	80.2	72.2	65.0	72.4	7.62	10.5	71.8	81.6	80.8	78.0	5.43	6.96
Acenaphthene	70.5	68.7	84.4	74.5	8.6	11.5	79.6	79.6	61.3	73.5	10.6	14.4	70.4	78.2	67.7	72.1	5.46	7.58
Dibenzofuran-d8 SS#2	79.9	68.0	91.9	79.9	12.0	14.9	77.7	74.6	64.5	72.3	6.91	9.56	76.2	81.7	99.2	85.7	12.0	14.0
Dibenzofuran	68.8	74.8	84.5	76.0	7.90	10.4	71.7	67.4	60.9	66.7	5.41	8.12	69.0	80.2	93.5	80.9	12.2	15.1
Fluorene	69.5	77.2	78.9	75.2	5.01	6.66	88.6	80.7	78.0	82.4	5.54	6.72	86.4	102	99.2	95.7	8.19	8.56
Dibenzothiophene	64.3	74.8	80.1	73.1	8.04	11.0	90.1	87.4	70.3	82.6	10.7	13.0	72.8	80.9	91.7	81.8	9.45	11.5
Phenanthrene	57.9	60.9	77.4	65.4	10.5	16.1	73.8	72.3	70.1	72.1	1.86	2.58	74.5	89.7	70.2	78.1	10.3	13.1
Anthracene-d10 SS#3	77.5	83.4	87.0	82.6	4.79	5.80	81.9	78.6	75.3	78.6	3.28	4.17	72.3	88.1	78.4	79.6	8.00	10.0
Anthracene	62.2	56.1	77.4	65.2	11.0	16.8	92.1	85.6	82.9	86.9	4.73	5.44	62.3	75.1	81.4	72.9	9.72	13.3
Carbozole	61.6	67.0	75.5	68.0	6.97	10.2	58.0	53.9	53.4	55.1	2.53	4.59	69.0	82.1	96.5	82.6	13.8	16.7
4-methylbenzothiophene	57.4	61.8	70.3	63.2	6.54	10.3	62.0	55.8	57.7	58.5	3.18	5.44	85.2	103	98.2	95.3	9.06	9.50
2-methylphenanthrene	54.0	60.0	74.3	62.8	10.4	16.5	80.9	77.7	63.9	74.2	9.02	12.2	81.5	73.2	94.7	83.2	10.8	13.0
2-methylanthracene	66.2	73.6	78.4	72.7	6.12	8.42	91.3	87.6	69.4	82.8	11.7	14.2	80.9	97.5	77.7	85.4	10.6	12.5
1-methylphenanthrene	67.8	78.8	79.7	75.5	6.63	8.79	55.6	52.3	50.6	52.8	2.55	4.82	75.6	88.9	101	88.5	12.8	14.4
3,6-dimethylphenanthrene	62.4	70.1	87.9	73.4	13.1	17.8	68.2	66.2	64.1	66.2	2.05	3.09	73.6	81.8	97.2	84.2	12.0	14.2
Fluoranthene	76.3	83.9	90.7	83.6	7.19	8.60	82.9	80.4	72.1	78.5	5.64	7.19	74.3	87.4	75.9	79.2	7.16	9.04
Pyrene	75.5	65.3	86.5	75.8	10.6	14.0	53.6	52.5	46.1	50.7	4.06	8.00	64.7	79.9	84.4	76.3	10.3	13.5
Benzo (a) fluorene	63.1	70.1	89.0	74.1	13.4	18.1	89.4	89.4	81.3	86.7	4.64	5.36	46.5	55.3	58.3	53.4	6.17	11.6
1-methylpyrene	76.6	65.1	88.4	76.7	11.6	15.2	60.9	59.1	49.9	56.6	5.87	10.4	69.2	86.5	83.2	79.6	9.18	11.5
Benzo (a) anthracene - d12 SS#	71.0	67.7	90.9	76.5	12.6	16.4	59.1	53.8	44.9	52.6	7.17	13.6	70.8	86.4	104	87.1	16.7	19.2
Benzo (a) anthracene	78.2	64.6	86.2	76.3	10.9	14.3	96.7	88.9	88.9	91.5	4.46	4.88	72.2	81.1	87.4	80.2	7.62	9.50
Chrysene	74.0	78.7	90.5	81.1	8.52	10.5	75.6	71.8	71.8	73.1	2.18	2.99	72.7	87.6	100	86.8	13.7	15.8
5-methylchrysene	71.9	77.3	78.1	75.8	3.39	4.47	89.3	85.7	83.0	86.0	3.14	3.65	80.3	99.2	89.4	89.6	9.42	10.5
Benzo (b) fluoranthene	42.8	45.5	54.0	47.4	5.87	12.4	64.0	59.5	53.1	58.9	5.47	9.29	42.2	50.9	51.8	48.3	5.27	10.9
Benzo (k) fluoranthene	67.4	76.6	80.9	75.0	6.87	9.17	65.5	63.5	61.5	63.5	1.96	3.09	69.0	76.6	90.9	78.8	11.1	14.1
Benzo (e) pyrene	68.8	62.5	80.4	70.6	9.1	12.8	77.9	74.0	60.8	70.9	8.98	12.7	90.3	100	90.6	93.7	5.69	6.07
Benzo (a) pyrene - d12 SS#5	62.7	70.5	79.2	70.8	8.23	11.6	61.6	61.0	56.7	59.8	2.69	4.49	86.6	96.3	85.6	89.5	5.89	6.58
Benzo (a) Pyrene	54.4	62.5	63.8	60.2	5.12	8.50	62.4	58.1	49.9	56.8	6.34	11.2	70.6	83.1	70.4	74.7	7.24	9.69
Perylene	31.2	33.2	44.1	36.2	6.95	19.2	88.3	82.2	67.1	79.2	10.9	13.8	54.8	63.0	71.6	63.2	8.38	13.3
Indeno (1,2,3 - cd) pyrene	54.4	57.9	61.3	57.9	3.44	5.94	69.7	69.0	52.3	63.7	9.87	15.5	97.7	89.2	80.4	89.1	8.67	9.73
Dibenzo (a,h) anthracene	44.7	49.7	50.8	48.4	3.23	6.68	55.2	54.6	44.2	51.3	6.22	12.1	75.4	86.6	92.9	85.0	8.87	10.4
Benzo (g,h,i) perylene	52.6	55.9	63.2	57.2	5.41	9.46	67.2	63.8	50.4	60.5	8.89	14.7	61.9	73.7	61.2	65.6	7.02	10.7
Avg. total PAH recovery (%)				70.3						68.6						79.5		

Table A.1. Summary of the PAH (ng/g, dry wt) recoveries, std. deviation, and %RSD for preliminary efficacy study (continued).

PAH	Solvent ID 10 99% MeCN 1%AA					
	1	2	3	Avg.	StdDev	%RSD
Naphthalene	47.2	44.4	43.9	45.2	1.79	3.96
Benzothiophene	51.2	60.9	59.4	57.2	5.23	9.15
2-methylnaphthalene	49.6	57.5	55.1	54.1	4.06	7.51
1-methylnaphthalene-d10 SS#1	58.4	56.1	57.8	57.4	1.22	2.12
Biphenyl	71.2	68.4	84.0	74.5	8.34	11.2
2-ethylnaphthalene	66.3	67.0	76.9	70.1	5.94	8.48
Acenaphthylene	59.1	65.0	53.2	59.1	5.91	10.0
Acenaphthene	55.2	50.8	54.6	53.5	2.41	4.49
Dibenzofuran-d8 SS#2	68.9	79.2	77.2	75.1	5.47	7.28
Dibenzofuran	75.8	83.4	81.1	80.1	3.89	4.86
Fluorene	68.3	70.3	73.1	70.6	2.40	3.40
Dibenzothiophene	51.2	48.1	54.8	51.4	3.33	6.48
Phenanthrene	66.8	76.2	70.1	71.0	4.74	6.67
Anthracene-d10 SS#3	76.4	74.1	70.3	73.6	3.09	4.20
Anthracene	72.9	83.1	66.3	74.1	8.45	11.4
Carbozole	68.3	74.4	71.0	71.3	3.08	4.32
4-methylbenzothiophene	59.7	55.5	69.3	61.5	7.04	11.4
2-methylphenanthrene	61.4	69.4	73.7	68.2	6.23	9.14
2-methylanthracene	78.6	71.5	85.7	78.6	7.07	9.00
1-methylphenanthrene	75.4	81.4	79.9	78.9	3.14	3.98
3,6-dimethylphenanthrene	72.9	84.6	86.8	81.4	7.45	9.15
Fluoranthene	66.1	65.4	78.0	69.8	7.07	10.1
Pyrene	70.9	85.1	75.2	77.0	7.28	9.44
Benzo (a) fluorene	70.5	83.9	68.4	74.3	8.41	11.3
1-methylpyrene	59.5	71.4	63.7	64.9	6.04	9.31
Benzo (a) anthracene - d12 SS#	67.8	65.8	78.0	70.5	6.54	9.27
Benzo (a) anthracene	64.3	64.9	70.1	66.4	3.17	4.77
Chrysene	70.9	70.9	67.4	69.7	2.05	2.94
5-methylchrysene	73.6	77.3	82.4	77.8	4.44	5.70
Benzo (b) fluoranthene	67.8	71.2	78.0	72.3	5.18	7.16
Benzo (k) fluoranthene	59.7	66.3	66.3	64.1	3.79	5.92
Benzo (e) pyrene	65.5	61.6	71.4	66.2	4.95	7.48
Benzo (a) pyrene - d12 SS#5	50.9	46.3	56.0	51.1	4.84	9.47
Benzo (a) Pyrene	69.9	78.3	69.2	72.5	5.06	6.98
Perylene	55.4	52.6	59.8	56.0	3.63	6.49
Indeno (1,2,3 - cd) pyrene	59.4	62.4	54.6	58.8	3.90	6.62
Dibenzo (a,h) anthracene	53.7	51.0	49.9	51.6	1.94	3.76
Benzo (g,h,i) perylene	48.7	51.6	51.1	50.5	1.57	3.10
Avg. total PAH recovery (%)				66.3		

Table A.2. Summary of the PAH (ng/g, dry wt) recoveries, std. deviation, and %RSD for final efficacy study.

PAH	Solvent ID																	
	6A 40% ACE 40% MEK 20% CH						6B 30% ACE 30% MEK 40% CH						6C 10% ACE 20% MEK 70% CH					
	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD
Naphthalene	7.57	8.49	8.77	8.28	0.623	7.53	8.42	8.71	7.82	8.32	0.453	5.45	8.73	8.64	9.42	8.93	0.430	4.82
Benzothiophene	8.52	10.0	7.84	8.78	1.10	12.5	8.75	9.14	8.46	8.78	0.340	3.87	8.28	8.04	8.28	8.20	0.139	1.70
2-methylnaphthalene	8.07	9.00	8.25	8.44	0.491	5.82	8.36	7.64	8.87	8.29	0.619	7.47	7.89	8.13	8.52	8.18	0.318	3.89
1-methylnaphthalene-d10 SS#1	8.00	9.75	9.11	8.95	0.886	9.90	9.28	9.46	9.82	9.52	0.275	2.89	10.1	9.68	10.8	10.2	0.554	5.44
Biphenyl	9.47	8.37	8.64	8.83	0.572	6.48	10.3	9.73	8.96	9.66	0.673	6.96	9.68	9.31	10.26	9.75	0.480	4.93
2-ethylnaphthalene	7.44	9.17	8.64	8.42	0.888	10.6	8.77	8.75	9.44	8.99	0.393	4.38	7.71	7.56	8.33	7.87	0.407	5.17
Acenaphthylene	8.42	9.23	8.61	8.75	0.420	4.80	8.67	8.18	9.25	8.70	0.536	6.16	8.64	8.8	8.90	8.78	0.132	1.51
Acenaphthene	7.16	7.45	8.25	7.62	0.561	7.36	8.45	8.98	8.58	8.67	0.278	3.21	7.98	8.40	8.22	8.20	0.211	2.57
Dibenzofuran-d8 SS#2	8.97	10.4	8.61	9.33	0.950	10.2	8.08	8.81	9.37	8.75	0.650	7.42	7.97	8.39	8.37	8.24	0.236	2.87
Dibenzofuran	7.69	9.16	8.58	8.48	0.739	8.72	9.16	9.57	10.1	9.61	0.472	4.91	9.41	9.05	9.98	9.48	0.467	4.93
Fluorene	6.84	7.32	7.72	7.29	0.443	6.08	8.22	8.98	7.26	8.15	0.86	10.6	8.11	7.95	8.03	8.03	0.080	0.99
Dibenzothiophene	7.68	7.13	7.21	7.34	0.296	4.03	8.91	9.54	9.49	9.31	0.351	3.77	8.24	8.16	8.65	8.35	0.265	3.17
Phenanthrene	9.04	8.70	9.26	9.00	0.280	3.11	9.14	8.56	9.65	9.12	0.544	5.97	9.35	9.35	10.1	9.60	0.432	4.50
Anthracene-d10 SS#3	7.52	7.99	7.91	7.81	0.251	3.22	9.77	8.60	8.49	8.95	0.710	7.93	8.79	8.45	9.49	8.91	0.531	5.96
Anthracene	7.70	9.9	9.30	8.98	1.15	12.9	8.93	8.49	9.40	8.94	0.455	5.09	7.63	7.63	7.94	7.74	0.176	2.28
Carbozole	7.58	8.77	8.50	8.29	0.625	7.55	9.87	8.72	9.02	9.20	0.597	6.48	7.05	7.34	7.40	7.27	0.189	2.60
4-methylbenzothiophene	8.86	8.99	9.57	9.14	0.379	4.15	10.50	8.69	8.16	9.12	1.226	13.5	7.64	7.56	7.94	7.71	0.202	2.62
2-methylphenanthrene	7.24	8.92	8.75	8.30	0.925	11.1	8.59	8.56	8.82	8.66	0.145	1.68	9.44	9.16	9.82	9.47	0.328	3.46
2-methylanthracene	7.47	9.76	8.91	8.71	1.16	13.3	9.80	9.40	9.44	9.55	0.219	2.30	9.26	8.82	9.91	9.33	0.548	5.87
1-methylphenanthrene	8.05	9.12	9.40	8.86	0.710	8.01	10.60	9.16	9.08	9.62	0.85	8.88	8.14	7.75	8.38	8.09	0.319	3.94
3,6-dimethylphenanthrene	8.49	9.06	8.27	8.61	0.405	4.71	9.72	8.99	10.5	9.72	0.73	7.54	9.14	8.79	7.68	8.54	0.763	8.94
Fluoranthene	8.84	9.87	9.32	9.34	0.517	5.54	9.95	9.80	9.75	9.83	0.10	1.06	8.19	8.53	8.27	8.33	0.178	2.14
Pyrene	9.45	9.99	9.41	9.62	0.324	3.37	8.51	9.02	9.73	9.09	0.613	6.75	7.79	7.64	7.72	7.72	0.076	0.99
Benzo (a) fluorene	6.57	8.56	8.17	7.77	1.06	13.6	8.98	7.35	7.68	8.00	0.863	10.8	6.78	7.06	6.98	6.94	0.146	2.10
1-methylpyrene	8.42	8.12	8.71	8.42	0.296	3.52	9.66	8.83	9.10	9.19	0.424	4.62	8.45	8.05	9.12	8.54	0.545	6.38
Benzo (a) anthracene - d12 SS#4	8.42	8.52	9.06	8.67	0.343	3.96	9.71	8.07	8.66	8.81	0.832	9.44	8.51	8.95	8.51	8.65	0.258	2.99
Benzo (a) anthracene	8.48	9.39	9.01	8.96	0.458	5.11	9.63	8.95	8.87	9.15	0.419	4.58	7.85	7.62	7.85	7.77	0.132	1.70
Chrysene	7.30	8.23	8.63	8.05	0.683	8.48	10.70	9.16	8.24	9.37	1.243	13.3	9.02	9.20	9.38	9.20	0.180	1.96
5-methylchrysene	7.80	9.02	9.67	8.83	0.950	10.8	8.10	9.37	9.83	9.10	0.895	9.84	7.71	7.95	7.71	7.79	0.138	1.77
Benzo (b) fluoranthene	6.08	6.03	6.42	6.17	0.211	3.42	9.53	8.43	8.96	8.97	0.550	6.13	6.74	6.42	6.94	6.70	0.264	3.94
Benzo (k) fluoranthene	8.14	8.41	9.84	8.80	0.913	10.4	9.33	8.57	9.21	9.04	0.407	4.51	8.51	8.11	9.11	8.58	0.504	5.87
Benzo (e) pyrene	9.16	9.75	8.86	9.26	0.451	4.87	8.34	9.17	10.2	9.24	0.938	10.2	8.64	8.55	8.81	8.66	0.132	1.52
Benzo (a) pyrene - d12 SS#5	8.10	9.16	9.44	8.90	0.708	7.95	8.37	8.53	8.45	8.45	0.081	0.954	7.13	7.36	7.56	7.35	0.214	2.91
Benzo (a) Pyrene	7.71	7.59	7.59	7.63	0.070	0.920	8.10	8.76	9.10	8.65	0.509	5.89	5.98	6.29	5.92	6.06	0.201	3.32
Perylene	7.36	7.87	7.23	7.49	0.339	4.53	8.74	7.91	8.24	8.30	0.418	5.03	6.31	6.50	6.37	6.40	0.100	1.56
Indeno (1,2,3 - cd) pyrene	7.66	7.80	7.04	7.50	0.404	5.38	8.82	8.40	8.14	8.45	0.341	4.04	6.73	6.41	7.00	6.72	0.295	4.40
Dibenzo (a,h) anthracene	7.24	7.43	7.48	7.38	0.131	1.78	8.51	7.56	7.50	7.86	0.567	7.21	6.56	6.56	7.02	6.71	0.265	3.95
Benzo (g,h,i) perylene	7.23	7.85	7.33	7.47	0.334	4.47	8.60	7.54	8.46	8.20	0.578	7.05	6.36	6.56	6.87	6.60	0.257	3.89
Avg. total PAH recovery (%)				83.8						89.3						81.5		

Table A.2. Summary of the PAH (ng/g, dry wt) recoveries, std. deviation, and %RSD for final efficacy study (continued).

PAH	Solvent ID																	
	9A						9B						9C					
	50% ACE 40% EA 10% ISO						40% ACE 40% EA 20% ISO						30% ACE 30% EA 40% ISO					
	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD
Naphthalene	6.80	6.29	6.83	6.64	0.303	4.56	8.38	7.37	8.96	8.24	0.802	9.74	9.30	9.20	9.28	9.26	0.050	0.535
Benzothiophene	8.24	7.47	7.14	7.62	0.564	7.40	8.18	7.69	9.73	8.54	1.06	12.5	9.07	8.40	9.49	8.99	0.551	6.13
2-methylnaphthalene	5.85	7.05	6.50	6.47	0.600	9.28	7.35	6.62	7.78	7.25	0.587	8.10	7.44	7.22	9.04	7.90	1.00	12.6
1-methylnaphthalene-d10 SS#1	7.45	8.37	6.19	7.33	1.091	14.9	8.27	7.85	8.97	8.36	0.567	6.78	10.1	9.74	9.83	9.90	0.205	2.07
Biphenyl	7.08	8.64	6.79	7.50	0.991	13.2	8.70	8.26	9.82	8.93	0.804	9.01	9.70	8.51	7.47	8.56	1.11	13.0
2-ethylnaphthalene	5.46	6.50	7.41	6.46	0.976	15.1	6.66	5.92	6.95	6.51	0.529	8.12	7.73	6.78	7.31	7.28	0.476	6.54
Acenaphthylene	7.18	6.16	8.08	7.14	0.959	13.4	7.54	6.56	8.30	7.47	0.873	11.7	7.22	7.60	8.89	7.90	0.876	11.1
Acenaphthene	7.04	7.82	6.77	7.21	0.546	7.58	7.42	6.60	8.08	7.37	0.737	10.0	8.67	8.34	8.19	8.40	0.248	2.96
Dibenzofuran-d8 SS#2	6.62	7.17	6.92	6.90	0.28	4.01	8.95	7.78	9.65	8.79	0.942	10.7	7.87	7.35	7.35	7.52	0.297	3.95
Dibenzofuran	6.90	8.02	9.35	8.09	1.22	15.1	8.27	7.28	8.82	8.12	0.782	9.63	8.04	7.18	7.41	7.54	0.446	5.91
Fluorene	8.64	10.2	9.92	9.57	0.819	8.56	8.54	7.34	9.06	8.31	0.881	10.6	9.71	8.45	8.53	8.90	0.709	7.97
Dibenzothiophene	7.28	8.09	9.17	8.18	0.945	11.5	9.51	9.04	9.70	9.42	0.341	3.63	6.81	7.17	7.39	7.12	0.296	4.15
Phenanthrene	7.45	8.97	7.02	7.81	1.03	13.1	7.68	7.06	8.15	7.63	0.546	7.15	10.2	10.1	9.08	9.82	0.642	6.54
Anthracene-d10 SS#3	7.23	8.81	7.84	7.96	0.800	10.0	7.90	6.96	8.61	7.82	0.829	10.6	6.52	6.86	6.43	6.61	0.227	3.44
Anthracene	6.23	7.51	8.14	7.29	0.972	13.3	9.06	7.89	8.75	8.57	0.610	7.12	7.90	7.90	8.66	8.16	0.439	5.38
Carbozole	6.90	8.21	9.65	8.26	1.38	16.7	7.18	6.32	8.22	7.24	0.951	13.1	7.78	7.07	6.87	7.24	0.478	6.61
4-methylbenzothiophene	8.52	10.3	9.82	9.53	0.906	9.50	8.23	7.82	9.88	8.64	1.09	12.6	5.15	5.31	5.43	5.30	0.139	2.63
2-methylphenanthrene	6.15	7.32	8.47	7.31	1.16	15.8	8.54	8.11	9.50	8.72	0.710	8.14	7.22	7.08	8.38	7.56	0.713	9.44
2-methylanthracene	8.09	9.75	7.77	8.54	1.06	12.5	6.90	6.07	7.80	6.93	0.865	12.5	7.30	6.52	6.71	6.84	0.407	5.95
1-methylphenanthrene	7.56	8.89	8.11	8.19	0.67	8.19	7.60	6.46	7.60	7.22	0.658	9.12	6.48	6.48	7.02	6.66	0.312	4.68
3,6-dimethylphenanthrene	7.36	8.18	8.72	8.09	0.68	8.45	9.31	8.75	9.84	9.30	0.544	5.84	8.17	7.23	8.49	7.96	0.655	8.22
Fluoranthene	7.43	8.74	7.59	7.92	0.716	9.04	7.08	6.59	7.74	7.14	0.575	8.06	7.66	7.44	6.70	7.27	0.502	6.92
Pyrene	6.47	7.99	8.44	7.63	1.03	13.5	8.64	7.24	7.62	7.83	0.724	9.24	9.40	9.90	8.61	9.30	0.647	6.95
Benzo (a) fluorene	4.65	5.53	5.83	5.34	0.617	11.6	5.47	5.09	5.95	5.50	0.433	7.86	4.77	4.63	4.17	4.52	0.313	6.91
1-methylpyrene	6.92	8.65	8.32	7.96	0.918	11.5	8.55	7.69	8.71	8.32	0.548	6.59	9.76	9.52	9.10	9.46	0.337	3.56
Benzo (a) anthracene - d12 SS#4	7.08	8.64	9.42	8.38	1.19	14.2	7.63	6.86	8.77	7.75	0.960	12.4	8.58	9.03	8.00	8.54	0.517	6.06
Benzo (a) anthracene	7.22	8.11	8.74	8.02	0.762	9.50	8.60	7.91	8.76	8.42	0.452	5.37	9.68	8.96	9.52	9.39	0.377	4.01
Chrysene	7.27	8.76	10.0	8.68	1.37	15.8	8.13	7.23	8.61	7.99	0.699	8.75	9.84	9.75	10.5	10.0	0.412	4.11
5-methylchrysene	8.03	9.92	8.94	8.96	0.942	10.5	9.10	7.73	9.19	8.67	0.815	9.39	10.3	10.8	8.63	9.91	1.136	11.5
Benzo (b) fluoranthene	4.22	5.09	5.18	4.83	0.527	10.9	4.01	3.65	4.64	4.10	0.504	12.3	6.21	5.86	5.97	6.01	0.180	2.99
Benzo (k) fluoranthene	6.90	7.66	9.09	7.88	1.11	14.1	8.98	8.44	10.1	9.18	0.860	9.37	10.1	10.2	9.91	10.1	0.146	1.45
Benzo (e) pyrene	9.03	10.0	9.06	9.37	0.569	6.07	10.2	9.22	9.87	9.78	0.518	5.30	8.71	11.0	10.1	9.96	1.17	11.8
Benzo (a) pyrene - d12 SS#5	8.66	9.63	8.56	8.95	0.589	6.58	9.35	8.51	9.94	9.27	0.719	7.76	9.34	9.16	9.24	9.25	0.092	0.99
Benzo (a) Pyrene	7.06	8.31	7.04	7.47	0.724	9.69	8.07	7.10	8.87	8.01	0.885	11.0	8.56	8.65	7.28	8.17	0.765	9.37
Perylene	5.48	6.30	7.16	6.32	0.838	13.3	6.72	6.36	7.82	6.97	0.760	10.91	6.61	6.24	6.12	6.32	0.255	4.04
Indeno (1,2,3 - cd) pyrene	9.77	8.92	8.04	8.91	0.867	9.73	6.88	6.12	6.88	6.62	0.437	6.59	8.44	9.16	7.16	8.25	1.01	12.3
Dibenzo (a,h) anthracene	7.54	8.66	9.29	8.50	0.887	10.4	7.41	7.04	8.28	7.58	0.633	8.36	8.84	9.30	8.75	8.96	0.297	3.31
Benzo (g,h,i) perylene	6.19	7.37	6.12	6.56	0.702	10.7	5.38	4.68	6.13	5.40	0.723	13.4	8.75	8.75	6.84	8.11	1.10	13.6
				77.3						78.4						81.3		

Table A.2. Summary of the PAH (ng/g, dry wt) recoveries, std. deviation, and %RSD for final efficacy study (continued).

PAH	Solvent ID 10 99% MeCN 1%AA					
	1	2	3	Avg.	StdDev	%RSD
Naphthalene	5.72	5.44	6.39	5.85	0.489	8.37
Benzothiophene	6.12	6.09	5.94	6.05	0.097	1.61
2-methylnaphthalene	5.96	5.75	5.51	5.74	0.228	3.96
1-methylnaphthalene-d10 SS#1	5.84	5.61	5.78	5.74	0.122	2.12
Biphenyl	7.12	6.84	8.40	7.45	0.834	11.2
2-ethylnaphthalene	6.63	6.70	7.69	7.01	0.594	8.48
Acenaphthylene	5.91	6.50	5.32	5.91	0.591	10.0
Acenaphthene	6.52	7.08	6.46	6.69	0.339	5.08
Dibenzofuran-d8 SS#2	6.89	7.92	7.72	7.51	0.547	7.28
Dibenzofuran	7.58	8.34	8.11	8.01	0.389	4.86
Fluorene	6.83	7.03	7.31	7.06	0.240	3.40
Dibenzothiophene	5.12	6.81	5.48	5.80	0.892	15.4
Phenanthrene	6.68	7.62	7.01	7.10	0.474	6.67
Anthracene-d10 SS#3	7.64	7.41	7.03	7.36	0.309	4.20
Anthracene	7.29	8.31	6.63	7.41	0.845	11.4
Carbozole	6.83	7.44	7.10	7.13	0.308	4.32
4-methylbenzothiophene	5.97	5.55	6.93	6.15	0.704	11.4
2-methylphenanthrene	6.14	6.94	7.37	6.82	0.623	9.14
2-methylanthracene	7.86	7.15	8.57	7.86	0.707	9.00
1-methylphenanthrene	7.54	8.14	7.99	7.89	0.314	3.98
3,6-dimethylphenanthrene	7.29	8.46	8.68	8.14	0.745	9.15
Fluoranthene	6.61	6.54	7.80	6.98	0.707	10.1
Pyrene	7.09	8.51	7.52	7.70	0.728	9.44
Benzo (a) fluorene	7.05	8.39	7.84	7.76	0.673	8.68
1-methylpyrene	6.95	7.14	6.37	6.82	0.403	5.91
Benzo (a) anthracene - d12 SS#4	6.78	6.58	7.80	7.05	0.654	9.27
Benzo (a) anthracene	6.43	6.49	7.01	6.64	0.317	4.77
Chrysene	7.09	7.09	6.74	6.97	0.205	2.94
5-methylchrysene	7.36	7.73	8.24	7.78	0.444	5.70
Benzo (b) fluoranthene	6.78	7.12	7.80	7.23	0.518	7.16
Benzo (k) fluoranthene	5.97	6.63	6.63	6.41	0.379	5.92
Benzo (e) pyrene	6.55	6.16	7.14	6.62	0.495	7.48
Benzo (a) pyrene - d12 SS#5	5.09	4.63	5.60	5.11	0.484	9.47
Benzo (a) Pyrene	6.99	7.83	6.92	7.25	0.506	6.98
Perylene	5.54	5.26	5.98	5.60	0.363	6.49
Indeno (1,2,3 - cd) pyrene	5.94	6.24	5.46	5.88	0.390	6.62
Dibenzo (a,h) anthracene	5.37	5.10	4.99	5.16	0.194	3.76
Benzo (g,h,i) perylene	4.87	5.16	5.11	5.05	0.157	3.10
				67.5		

Table A.3. Summary of the PAH (ng/g, dry wt) recoveries, std. deviation, and %RSD for ultrasonic-assisted extraction study.

PAH	Ultrasonic-assisted (25% Amplitude)																	
	2 min						4 min						6 min					
	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD
Naphthalene	7.67	6.75	7.54	7.32	0.499	6.81	7.83	7.18	7.85	7.62	0.381	5.00	6.25	6.03	6.35	6.21	0.163	2.63
Benzothiophene	7.21	7.30	7.58	7.36	0.194	2.63	7.36	7.45	7.82	7.54	0.243	3.22	6.20	6.26	6.97	6.48	0.428	6.61
2-methylnaphthalene	6.64	7.03	6.97	6.88	0.212	3.08	6.77	7.48	7.26	7.17	0.362	5.05	5.95	6.83	6.13	6.30	0.463	7.35
1-methylnaphthalene-d10 SS#1	6.84	7.38	7.85	7.35	0.508	6.90	7.12	7.53	8.01	7.55	0.445	5.90	6.34	6.49	7.41	6.75	0.581	8.60
Biphenyl	7.83	8.09	7.68	7.87	0.205	2.60	8.24	8.51	8.17	8.31	0.179	2.16	7.51	6.55	7.46	7.17	0.536	7.47
2-ethylnaphthalene	8.23	7.89	7.73	7.95	0.257	3.23	8.40	8.31	8.22	8.31	0.089	1.07	6.85	6.23	5.67	6.25	0.590	9.44
Acenaphthylene	8.44	8.63	8.89	8.65	0.227	2.62	8.98	9.08	9.26	9.11	0.144	1.58	7.16	8.40	7.00	7.52	0.762	10.1
Acenaphthene	8.47	8.64	8.54	8.55	0.087	1.02	8.91	8.82	8.99	8.91	0.088	0.991	6.68	7.80	6.52	7.00	0.699	9.99
Dibenzofuran-d8 SS#2	8.28	7.99	7.75	8.01	0.266	3.32	8.72	8.15	8.07	8.31	0.351	4.22	7.28	7.92	7.27	7.49	0.375	5.01
Dibenzofuran	10.0	8.89	9.08	9.34	0.617	6.61	10.5	9.36	9.27	9.70	0.664	6.85	7.04	7.84	7.28	7.39	0.412	5.58
Fluorene	7.92	7.92	7.69	7.84	0.136	1.74	8.43	8.43	8.09	8.32	0.195	2.34	8.93	10.1	8.68	9.22	0.733	7.95
Dibenzothiophene	8.47	9.06	9.41	8.98	0.475	5.29	8.92	9.34	9.80	9.35	0.443	4.74	7.62	7.99	6.97	7.53	0.516	6.86
Phenanthrene	7.89	8.32	7.83	8.01	0.270	3.37	8.40	8.49	8.07	8.32	0.223	2.68	9.47	9.04	9.40	9.30	0.228	2.45
Anthracene-d10 SS#3	7.33	7.24	7.02	7.20	0.162	2.24	7.64	7.38	7.31	7.44	0.172	2.31	10.1	8.70	10.0	9.59	0.775	8.08
Anthracene	8.50	9.28	9.66	9.15	0.593	6.48	9.05	9.88	10.2	9.70	0.585	6.03	8.43	7.42	7.95	7.93	0.504	6.35
Carbozole	9.94	9.64	9.65	9.74	0.172	1.76	10.1	10.3	9.95	10.1	0.156	1.54	8.44	8.29	8.62	8.45	0.166	1.96
4-methylbenzothiophene	6.97	7.86	8.44	7.76	0.736	9.49	7.27	8.02	8.88	8.06	0.808	10.0	8.62	9.85	9.99	9.49	0.752	7.93
2-methylphenanthrene	7.47	8.13	7.80	7.80	0.333	4.27	7.94	8.38	8.30	8.21	0.234	2.85	7.57	7.39	8.67	7.88	0.689	8.75
2-methylanthracene	8.43	8.34	8.09	8.28	0.176	2.13	8.78	8.68	8.34	8.60	0.233	2.71	9.81	9.45	9.92	9.72	0.247	2.54
1-methylphenanthrene	7.51	7.34	7.86	7.57	0.270	3.56	7.90	7.72	8.11	7.91	0.193	2.44	8.85	8.62	9.42	8.96	0.411	4.59
3,6-dimethylphenanthrene	9.33	9.33	8.86	9.17	0.273	2.97	9.82	9.62	9.42	9.62	0.201	2.09	9.32	7.93	8.92	8.72	0.713	8.18
Fluoranthene	7.97	8.52	8.52	8.33	0.319	3.83	8.39	8.87	8.78	8.68	0.260	2.99	9.74	8.65	9.06	9.15	0.550	6.01
Pyrene	8.40	8.13	8.55	8.36	0.212	2.54	8.66	8.47	8.72	8.62	0.133	1.54	8.47	7.59	9.21	8.42	0.812	9.65
Benzo (a) fluorene	8.46	7.42	7.96	7.95	0.522	6.57	8.64	7.81	8.12	8.19	0.417	5.09	7.90	7.75	6.57	7.41	0.730	9.86
1-methylpyrene	8.21	8.12	7.72	8.01	0.263	3.29	8.55	8.46	8.04	8.35	0.274	3.29	8.86	8.30	9.41	8.86	0.553	6.24
Benzo (a) anthracene - d12 SS#	8.03	7.25	8.38	7.88	0.577	7.31	8.54	7.71	8.63	8.29	0.507	6.12	9.28	8.72	8.69	8.90	0.331	3.72
Benzo (a) anthracene	7.65	7.25	8.30	7.73	0.531	6.87	7.80	7.71	8.56	8.03	0.465	5.79	8.42	7.78	8.40	8.20	0.360	4.40
Chrysene	8.85	9.43	8.97	9.08	0.310	3.42	9.22	9.63	9.34	9.39	0.210	2.24	8.63	8.76	9.40	8.93	0.412	4.62
5-methylchrysene	8.38	8.87	9.05	8.76	0.345	3.94	8.55	9.14	9.23	8.97	0.370	4.12	10.8	9.91	10.9	10.6	0.554	5.25
Benzo (b) fluoranthene	8.00	7.58	7.97	7.85	0.235	2.99	8.24	7.97	8.21	8.14	0.147	1.81	7.14	7.99	8.73	7.95	0.797	10.0
Benzo (k) fluoranthene	7.53	8.31	8.05	7.96	0.394	4.94	8.01	8.47	8.39	8.29	0.245	2.96	8.55	7.50	8.40	8.15	0.569	6.99
Benzo (e) pyrene	8.72	8.33	8.51	8.52	0.193	2.27	9.17	8.86	8.77	8.94	0.211	2.36	10.5	9.82	10.3	10.2	0.369	3.61
Benzo (a) pyrene - d12 SS#5	7.06	8.02	7.73	7.60	0.489	6.44	7.44	8.18	7.97	7.86	0.384	4.89	10.4	9.14	10.6	10.1	0.797	7.92
Benzo (a) Pyrene	7.52	7.79	8.12	7.81	0.298	3.81	7.92	8.28	8.28	8.16	0.210	2.58	9.22	8.04	8.93	8.73	0.612	7.01
Perylene	6.73	7.07	7.22	7.00	0.253	3.61	7.16	7.52	7.37	7.35	0.182	2.48	7.09	7.29	7.84	7.41	0.388	5.23
Indeno (1,2,3 - cd) pyrene	7.26	7.68	7.41	7.45	0.211	2.84	7.64	7.92	7.72	7.76	0.141	1.81	9.44	8.90	8.77	9.04	0.357	3.95
Dibenzo (a,h) anthracene	6.95	7.02	7.24	7.07	0.153	2.16	7.39	7.39	7.47	7.42	0.043	0.575	9.65	8.73	9.18	9.19	0.461	5.02
Benzo (g,h,i) perylene	7.94	7.32	7.40	7.55	0.341	4.51	8.19	7.78	7.79	7.92	0.232	2.93	8.36	8.20	7.93	8.2	0.218	2.68
Avg. total PAH recovery (%)				80.5						83.8						82.8		

Table A.3. Summary of the PAH (ng/g, dry wt) recoveries, std. deviation, and %RSD for ultrasonic-assisted extraction study (continued).

PAH	Ultrasonic-assisted (50% Amplitude) 2 min						4 min						6 min					
	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD
Naphthalene	7.61	7.02	7.18	7.27	0.306	4.21	7.04	7.47	7.55	7.35	0.279	3.79	6.05	6.29	6.42	6.25	0.188	3.00
Benzothiophene	6.80	6.96	7.46	7.08	0.345	4.87	7.24	7.10	6.80	7.05	0.222	3.15	6.14	6.47	7.20	6.60	0.540	8.18
2-methylnaphthalene	7.19	6.54	6.82	6.85	0.326	4.76	7.65	6.88	7.03	7.19	0.405	5.63	6.20	7.05	6.20	6.49	0.488	7.53
1-methylnaphthalene-d10 SS#1	7.52	7.35	6.86	7.24	0.345	4.77	7.92	7.50	7.29	7.57	0.317	4.19	7.28	6.37	6.30	6.65	0.547	8.23
Biphenyl	7.27	7.20	6.84	7.11	0.233	3.28	7.58	7.35	7.05	7.33	0.264	3.60	7.60	7.64	7.39	7.54	0.135	1.79
2-ethylnaphthalene	7.97	7.45	7.67	7.70	0.260	3.38	7.18	7.68	7.82	7.56	0.336	4.45	6.79	6.50	5.79	6.36	0.515	8.10
Acenaphthylene	7.87	8.12	7.40	7.80	0.367	4.70	8.29	8.46	7.71	8.15	0.394	4.83	7.10	6.16	6.93	6.73	0.502	7.46
Acenaphthene	8.31	7.69	8.67	8.22	0.494	6.01	8.56	8.19	9.03	8.59	0.425	4.95	6.96	7.82	6.72	7.17	0.576	8.04
Dibenzofuran-d8 SS#2	8.21	7.48	7.62	7.77	0.387	4.99	8.55	7.87	8.02	8.15	0.357	4.38	7.36	8.17	7.27	7.60	0.497	6.54
Dibenzofuran	8.00	7.20	8.60	7.93	0.703	8.86	8.42	7.66	8.96	8.35	0.653	7.82	6.98	8.02	7.22	7.41	0.546	7.37
Fluorene	7.83	8.40	8.48	8.24	0.354	4.30	8.16	8.66	8.66	8.49	0.288	3.39	8.94	10.2	9.14	9.42	0.653	6.94
Dibenzothiophene	8.07	7.96	8.80	8.28	0.456	5.51	8.59	8.21	8.98	8.59	0.386	4.50	7.88	8.09	7.04	7.67	0.556	7.25
Phenanthrene	9.71	10.2	10.0	10.0	0.234	2.36	9.91	10.6	10.5	10.3	0.374	3.62	9.87	8.97	9.23	9.35	0.462	4.94
Anthracene-d10 SS#3	8.42	9.83	9.99	9.41	0.865	9.19	8.96	10.0	10.3	9.76	0.711	7.28	9.87	8.81	10.04	9.58	0.667	6.97
Anthracene	8.08	8.79	8.63	8.50	0.370	4.36	8.25	9.15	9.0	8.80	0.483	5.49	8.63	7.51	8.03	8.06	0.563	6.99
Carbozole	8.48	8.20	8.13	8.27	0.189	2.29	8.93	8.7	8.65	8.8	0.148	1.69	8.71	8.21	8.62	8.51	0.264	3.10
4-methylbenzothiophene	9.02	8.63	9.17	8.94	0.278	3.11	9.39	8.90	9.65	9.32	0.384	4.12	9.19	10.27	9.91	9.79	0.549	5.60
2-methylphenanthrene	9.68	10.0	9.42	9.69	0.268	2.77	10.1	10.6	9.71	10.1	0.442	4.36	7.98	7.32	8.42	7.91	0.553	6.99
2-methylanthracene	9.51	10.5	9.9	10.0	0.470	4.71	9.71	10.8	10.6	10.4	0.569	5.49	10.1	9.75	10.2	10.0	0.254	2.53
1-methylphenanthrene	7.73	8.53	8.45	8.24	0.438	5.31	8.14	8.79	8.71	8.55	0.355	4.15	9.04	8.89	9.51	9.15	0.326	3.56
3,6-dimethylphenanthrene	8.94	9.5	9.57	9.32	0.340	3.64	9.41	10.1	9.97	9.81	0.356	3.63	9.24	8.18	8.75	8.73	0.532	6.10
Fluoranthene	8.51	9.4	9.03	8.99	0.462	5.14	8.96	10.0	9.40	9.46	0.540	5.70	9.97	8.74	9.35	9.35	0.612	6.54
Pyrene	9.49	8.08	8.49	8.69	0.728	8.38	10.1	8.51	8.75	9.12	0.859	9.42	9.11	7.99	8.95	8.68	0.605	6.97
Benzo (a) fluorene	7.87	8.79	8.32	8.33	0.459	5.51	8.12	9.25	8.85	8.74	0.576	6.59	8.09	7.53	6.92	7.51	0.583	7.76
1-methylpyrene	8.27	8.93	9.17	8.79	0.464	5.28	8.53	9.30	9.55	9.13	0.533	5.84	9.26	8.65	9.43	9.11	0.409	4.49
Benzo (a) anthracene - d12 SS#	8.93	9.99	10.09	9.7	0.642	6.64	9.40	10.6	10.6	10.2	0.706	6.91	9.50	8.64	9.15	9.10	0.435	4.78
Benzo (a) anthracene	8.20	9.26	10.0	9.17	0.921	10.0	8.46	9.65	10.3	9.48	0.957	10.1	8.52	8.11	8.76	8.46	0.328	3.87
Chrysene	9.34	10.3	9.72	9.79	0.495	5.06	9.94	10.5	10.2	10.2	0.298	2.91	9.29	8.76	9.90	9.32	0.570	6.12
5-methylchrysene	8.24	9.17	9.12	8.84	0.522	5.90	8.59	9.36	9.70	9.22	0.572	6.20	11.2	9.92	10.7	10.6	0.650	6.13
Benzo (b) fluoranthene	8.95	7.71	9.72	8.79	1.017	11.6	9.13	8.20	10.1	9.15	0.965	10.5	7.39	8.09	8.75	8.08	0.678	8.40
Benzo (k) fluoranthene	8.25	8.97	9.54	8.92	0.648	7.27	8.59	9.54	9.74	9.29	0.612	6.58	8.74	7.66	8.66	8.35	0.598	7.17
Benzo (e) pyrene	9.85	9.61	9.52	9.66	0.171	1.77	10.3	10.0	9.81	10.0	0.224	2.24	10.4	10.0	10.4	10.3	0.234	2.27
Benzo (a) pyrene - d12 SS#5	8.23	10.1	9.37	9.23	0.936	10.1	8.75	10.5	9.97	9.74	0.897	9.21	10.9	9.63	10.4	10.3	0.631	6.13
Benzo (a) Pyrene	8.60	8.58	9.15	8.78	0.327	3.73	8.86	8.75	9.44	9.02	0.368	4.08	9.14	8.31	9.30	8.91	0.534	5.99
Perylene	8.09	8.34	9.17	8.54	0.565	6.62	8.61	8.51	9.36	8.83	0.464	5.26	7.25	7.30	7.85	7.47	0.332	4.44
Indeno (1,2,3 - cd) pyrene	8.41	8.68	9.16	8.75	0.382	4.36	8.76	9.24	9.55	9.18	0.395	4.31	9.67	8.92	8.87	9.15	0.448	4.89
Dibenzo (a,h) anthracene	8.30	8.99	8.41	8.57	0.369	4.31	8.74	9.36	8.67	8.93	0.381	4.27	9.88	8.66	9.10	9.21	0.615	6.67
Benzo (g,h,i) perylene	8.37	8.49	8.09	8.32	0.209	2.52	8.81	8.76	8.60	8.72	0.107	1.23	8.81	8.37	8.18	8.46	0.324	3.83
Avg. total PAH recovery (%)				85.7						89.1						84.0		

Table A.3. Summary of the PAH (ng/g, dry wt) recoveries, std. deviation, and %RSD for ultrasonic-assisted extraction study (continued).

PAH	Ultrasonic-assisted (75% Amplitude)																	
	2 min						4 min						6 min					
	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD
Naphthalene	7.67	6.75	6.46	6.96	0.633	9.09	6.61	6.87	6.33	6.60	0.274	4.15	6.84	6.17	6.03	6.34	0.431	6.80
Benzothiophene	6.77	7.30	6.35	6.81	0.475	6.98	6.80	6.89	6.26	6.65	0.342	5.14	5.71	6.08	6.98	6.26	0.653	10.44
2-methylnaphthalene	6.50	7.18	6.11	6.60	0.542	8.21	6.03	6.68	6.47	6.39	0.327	5.12	5.96	6.77	6.08	6.27	0.438	6.98
1-methylnaphthalene-d10 SS#1	6.98	7.08	6.53	6.86	0.292	4.26	6.28	7.05	6.93	6.75	0.413	6.11	6.77	6.05	6.84	6.55	0.439	6.70
Biphenyl	7.00	7.12	7.68	7.27	0.365	5.02	7.05	6.84	6.49	6.79	0.283	4.16	7.07	7.33	6.94	7.11	0.198	2.78
2-ethylnaphthalene	8.07	7.89	7.81	7.92	0.129	1.63	6.61	7.07	7.35	7.01	0.376	5.37	6.58	6.31	5.67	6.19	0.468	7.56
Acenaphthylene	8.44	7.72	7.08	7.74	0.682	8.80	7.79	7.87	7.32	7.66	0.295	3.85	6.67	7.75	6.52	6.98	0.671	9.62
Acenaphthene	8.29	8.46	8.72	8.49	0.219	2.57	8.14	7.78	8.40	8.10	0.314	3.87	6.47	7.51	6.59	6.86	0.566	8.26
Dibenzofuran-d8 SS#2	8.45	7.91	7.59	7.98	0.438	5.49	7.87	7.24	7.30	7.47	0.345	4.62	6.84	7.93	7.13	7.30	0.563	7.72
Dibenzofuran	9.62	8.89	8.80	9.11	0.451	4.95	8.08	7.20	8.15	7.81	0.531	6.79	6.63	7.86	7.08	7.19	0.624	8.67
Fluorene	8.26	8.18	7.61	8.01	0.356	4.44	7.67	8.40	7.88	7.98	0.375	4.70	8.76	9.96	8.69	9.14	0.713	7.80
Dibenzothiophene	8.38	9.15	8.41	8.65	0.435	5.03	7.90	7.88	8.62	8.13	0.422	5.19	7.64	7.77	6.69	7.37	0.591	8.02
Phenanthrene	7.81	7.98	7.66	7.82	0.159	2.04	9.41	9.65	9.55	9.54	0.118	1.24	9.08	8.43	8.86	8.79	0.328	3.73
Anthracene-d10 SS#3	7.33	7.24	6.87	7.15	0.243	3.41	8.42	9.43	9.68	9.18	0.668	7.28	9.38	8.46	9.64	9.16	0.621	6.78
Anthracene	8.68	9.28	8.66	8.88	0.353	3.97	7.59	8.42	8.27	8.09	0.445	5.49	8.03	7.05	7.79	7.62	0.507	6.65
Carbozole	9.74	9.84	9.35	9.64	0.260	2.70	8.22	8.20	7.87	8.10	0.198	2.44	8.18	8.05	8.45	8.23	0.205	2.49
4-methylbenzothiophene	7.05	7.54	8.61	7.73	0.801	10.4	8.74	8.10	9.27	8.70	0.586	6.73	8.45	9.75	9.62	9.27	0.713	7.69
2-methylphenanthrene	7.54	7.96	7.97	7.83	0.243	3.10	9.27	9.75	8.94	9.32	0.407	4.36	7.66	7.10	8.17	7.65	0.533	6.97
2-methylanthracene	8.43	8.16	8.17	8.25	0.151	1.83	9.22	10.2	10.3	9.91	0.594	5.99	9.41	9.36	9.93	9.56	0.317	3.31
1-methylphenanthrene	7.67	7.34	7.70	7.57	0.202	2.67	7.65	8.53	8.01	8.06	0.440	5.46	8.40	8.71	9.13	8.75	0.366	4.18
3,6-dimethylphenanthrene	9.24	9.33	8.23	8.93	0.606	6.783	9.03	9.66	9.37	9.35	0.316	3.38	8.97	8.02	8.23	8.40	0.499	5.93
Fluoranthene	7.88	8.52	8.26	8.22	0.320	3.89	8.15	9.43	8.75	8.78	0.640	7.29	9.57	8.22	8.98	8.92	0.677	7.59
Pyrene	8.23	8.04	8.46	8.24	0.208	2.53	9.49	8.08	8.14	8.57	0.801	9.34	8.93	7.75	8.50	8.39	0.596	7.10
Benzo (a) fluorene	8.21	7.42	7.96	7.86	0.402	5.11	7.63	8.42	8.49	8.18	0.479	5.85	7.60	7.08	6.57	7.08	0.513	7.25
1-methylpyrene	8.04	8.04	7.72	7.93	0.186	2.34	8.02	8.74	9.27	8.67	0.627	7.23	8.89	8.13	9.15	8.72	0.527	6.04
Benzo (a) anthracene - d12 SS#	8.37	7.48	8.20	8.02	0.472	5.89	8.93	9.67	9.88	9.49	0.498	5.24	9.21	8.46	8.79	8.82	0.377	4.27
Benzo (a) anthracene	7.41	7.33	8.30	7.68	0.540	7.03	8.12	9.07	9.73	8.97	0.809	9.02	8.09	7.71	8.24	8.01	0.274	3.41
Chrysene	8.94	9.34	8.15	8.81	0.604	6.86	9.14	9.69	9.41	9.42	0.274	2.91	8.73	8.41	9.50	8.88	0.562	6.33
5-methylchrysene	8.04	8.96	8.86	8.62	0.506	5.87	8.16	8.70	8.93	8.60	0.396	4.61	10.3	9.42	10.5	10.1	0.573	5.68
Benzo (b) fluoranthene	7.91	7.74	8.05	7.90	0.158	1.99	8.49	7.54	9.72	8.58	1.093	12.7	6.95	7.60	8.40	7.65	0.726	9.49
Benzo (k) fluoranthene	7.61	7.97	8.22	7.93	0.306	3.85	7.82	8.68	8.96	8.49	0.594	7.00	8.21	7.43	8.40	8.01	0.512	6.39
Benzo (e) pyrene	8.72	8.51	8.60	8.61	0.105	1.21	9.75	9.51	9.32	9.53	0.213	2.24	10.1	9.83	9.81	9.92	0.175	1.76
Benzo (a) pyrene - d12 SS#5	7.14	7.69	7.57	7.47	0.290	3.89	8.32	9.98	9.37	9.22	0.841	9.12	10.0	9.14	10.08	9.75	0.522	5.35
Benzo (a) Pyrene	7.44	8.03	8.03	7.84	0.341	4.35	8.42	8.23	8.78	8.47	0.279	3.29	8.95	8.14	9.12	8.74	0.523	5.99
Perylene	7.01	7.29	7.07	7.13	0.147	2.07	8.09	7.92	8.71	8.24	0.414	5.02	7.10	7.16	7.61	7.29	0.280	3.84
Indeno (1,2,3 - cd) pyrene	7.03	7.52	7.48	7.35	0.272	3.70	8.32	8.50	8.88	8.57	0.284	3.31	9.38	8.56	8.60	8.85	0.460	5.20
Dibenzo (a,h) anthracene	6.95	7.24	7.02	7.07	0.155	2.19	7.95	8.52	7.89	8.12	0.347	4.27	9.28	8.40	8.91	8.87	0.442	4.98
Benzo (g,h,i) perylene	7.94	7.39	7.64	7.66	0.276	3.61	8.10	8.06	8.17	8.11	0.058	0.71	8.11	8.04	7.86	8.00	0.131	1.63
Avg. total PAH recovery (%)				79.1						83.1						80.8		

Table A.3. Summary of the PAH (ng/g, dry wt) recoveries, std. deviation, and %RSD for ultrasonic-assisted extraction study (continued).

PAH	Shaken 2 min						Shaken 4 min						Shaken 6 min					
	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD
Naphthalene	8.84	8.28	8.84	8.65	0.322	3.73	8.38	8.28	8.93	8.53	0.351	4.11	9.20	9.66	9.20	9.36	0.266	2.84
Benzothiophene	8.05	6.78	7.13	7.32	0.661	9.03	7.75	7.45	7.83	7.68	0.203	2.65	7.75	7.45	7.83	7.68	0.203	2.65
2-methylnaphthalene	7.60	7.45	7.52	7.52	0.075	1.00	7.92	7.76	7.84	7.84	0.078	1.00	7.92	7.76	7.84	7.84	0.078	1.00
1-methylnaphthalene-d10 SS#1	8.09	7.93	7.78	7.93	0.156	1.96	8.89	8.72	8.55	8.72	0.171	1.96	8.89	8.72	8.55	8.72	0.171	1.96
Biphenyl	8.70	8.09	7.86	8.22	0.435	5.29	8.19	8.61	8.36	8.39	0.211	2.51	8.19	8.61	8.36	8.39	0.211	2.51
2-ethylnaphthalene	8.02	8.43	9.18	8.54	0.590	6.91	8.44	8.87	8.61	8.64	0.217	2.51	8.44	8.87	8.61	8.64	0.217	2.51
Acenaphthylene	7.06	7.21	7.21	7.16	0.083	1.17	7.85	8.01	8.01	7.96	0.093	1.17	7.85	8.01	8.01	7.96	0.093	1.17
Acenaphthene	8.01	7.08	7.08	7.39	0.536	7.26	7.30	7.37	7.37	7.35	0.043	0.579	7.30	7.37	7.37	7.35	0.043	0.579
Dibenzofuran-d8 SS#2	8.10	8.68	8.26	8.35	0.300	3.59	8.61	9.23	8.79	8.88	0.319	3.59	8.61	9.23	8.79	8.88	0.319	3.59
Dibenzofuran	8.46	8.06	8.13	8.22	0.214	2.60	8.40	8.95	8.04	8.46	0.460	5.43	9.40	8.95	9.04	9.13	0.238	2.60
Fluorene	7.53	7.32	7.17	7.34	0.180	2.46	8.10	7.87	7.71	7.89	0.194	2.46	8.10	7.87	7.71	7.89	0.194	2.46
Dibenzothiophene	8.51	8.44	6.57	7.84	1.098	14.0	6.85	6.78	6.92	6.85	0.069	1.01	6.85	6.78	6.92	6.85	0.069	1.01
Phenanthrene	8.94	8.02	8.52	8.49	0.462	5.44	9.22	8.27	8.78	8.76	0.477	5.44	9.22	8.27	8.78	8.76	0.477	5.44
Anthracene-d10 SS#3	8.48	7.63	7.12	7.75	0.685	8.84	8.13	8.30	7.74	8.06	0.284	3.53	8.13	8.30	7.74	8.06	0.284	3.53
Anthracene	8.30	8.64	8.39	8.44	0.176	2.09	8.74	9.09	8.83	8.89	0.186	2.09	8.74	9.09	8.83	8.89	0.186	2.09
Carbozole	8.21	8.29	7.89	8.13	0.210	2.58	8.55	8.64	8.22	8.47	0.219	2.58	8.55	8.64	8.22	8.47	0.219	2.58
4-methylbenzothiophene	8.34	8.92	8.17	8.48	0.394	4.64	9.06	8.70	8.58	8.78	0.250	2.84	9.06	9.70	8.88	9.21	0.428	4.64
2-methylphenanthrene	8.89	8.29	7.52	8.23	0.690	8.38	8.14	8.55	7.75	8.14	0.402	4.93	8.14	8.55	7.75	8.14	0.402	4.93
2-methylanthracene	8.48	9.34	7.64	8.48	0.851	10.0	7.96	7.80	8.12	7.96	0.159	2.00	7.96	7.80	8.12	7.96	0.159	2.00
1-methylphenanthrene	8.62	8.12	8.29	8.34	0.252	3.02	9.07	8.55	8.72	8.78	0.265	3.02	9.07	8.55	8.72	8.78	0.265	3.02
3,6-dimethylphenanthrene	8.15	7.61	7.76	7.84	0.279	3.55	8.49	7.93	8.08	8.17	0.290	3.55	8.49	7.93	8.08	8.17	0.290	3.55
Fluoranthene	8.80	8.13	8.46	8.46	0.335	3.95	8.78	9.03	8.40	8.74	0.318	3.64	9.78	9.03	9.40	9.41	0.372	3.95
Pyrene	8.31	8.17	8.31	8.26	0.080	0.967	9.03	8.97	8.12	8.71	0.510	5.86	9.03	9.97	9.03	9.35	0.541	5.79
Benzo (a) fluorene	8.13	7.63	7.13	7.63	0.500	6.55	7.35	7.87	7.35	7.52	0.299	3.97	7.35	7.87	7.35	7.52	0.299	3.97
1-methylpyrene	7.54	7.69	7.39	7.54	0.149	1.98	8.11	8.27	7.95	8.11	0.161	1.98	8.11	8.27	7.95	8.11	0.161	1.98
Benzo (a) anthracene - d12 SS#	8.82	7.99	8.56	8.46	0.423	5.00	8.69	8.78	9.41	8.96	0.391	4.36	9.69	8.78	9.41	9.29	0.465	5.00
Benzo (a) anthracene	9.00	7.91	8.12	8.34	0.576	6.90	8.78	8.60	9.40	8.93	0.421	4.72	9.78	8.60	9.40	9.26	0.602	6.50
Chrysene	8.11	8.36	7.87	8.11	0.243	2.99	8.36	8.61	8.11	8.36	0.250	2.99	8.36	8.61	8.11	8.36	0.250	2.99
5-methylchrysene	8.28	8.53	8.44	8.42	0.129	1.54	8.53	8.79	8.71	8.68	0.133	1.54	8.53	8.79	8.71	8.68	0.133	1.54
Benzo (b) fluoranthene	7.59	5.54	5.65	6.26	1.155	18.5	6.22	6.16	6.28	6.22	0.062	0.990	6.22	6.16	6.28	6.22	0.062	0.990
Benzo (k) fluoranthene	8.01	7.69	8.09	7.93	0.210	2.65	8.80	8.45	8.89	8.71	0.231	2.65	8.80	8.45	8.89	8.71	0.231	2.65
Benzo (e) pyrene	9.10	9.01	8.67	8.93	0.229	2.57	9.23	8.91	9.53	9.22	0.310	3.36	10.00	9.91	9.53	9.81	0.252	2.57
Benzo (a) pyrene - d12 SS#5	8.24	8.57	8.24	8.35	0.191	2.28	8.95	8.31	8.95	8.74	0.370	4.24	8.95	9.31	8.95	9.07	0.207	2.28
Benzo (a) Pyrene	6.96	7.04	6.96	6.99	0.042	0.597	7.18	7.25	7.18	7.20	0.043	0.597	7.18	7.25	7.18	7.20	0.043	0.597
Perylene	6.41	5.86	6.28	6.18	0.285	4.60	6.67	6.11	6.54	6.44	0.297	4.60	6.67	6.11	6.54	6.44	0.297	4.60
Indeno (1,2,3 - cd) pyrene	6.20	6.14	6.14	6.16	0.035	0.572	6.89	6.82	6.82	6.85	0.039	0.572	6.89	6.82	6.82	6.85	0.039	0.572
Dibenzo (a,h) anthracene	7.04	6.65	6.32	6.67	0.361	5.41	7.82	6.39	6.13	6.78	0.909	13.41	7.82	7.39	8.13	7.78	0.370	4.75
Benzo (g,h,i) perylene	6.07	6.21	6.74	6.34	0.349	5.51	6.45	6.59	7.09	6.71	0.338	5.04	7.45	7.59	7.09	7.38	0.258	3.50
Avg. total PAH recovery (%)				78.3						81.1						82.8		

Table A.4. Summary of co-extractive gravimetric determinations for the co-extractive clean-up study

Cleanup regime	$MgSO_4$/C18/PSA Composition (mg)/ml	Co-extractable (% by wt)					
		#1	#2	#3	#4	#5	Avg.
Traditioanl dSPE	150/50/50	0.28957	0.44069	0.45386	0.35886	0.30113	0.36882
+25% dSPE	188/63/63	0.18289	0.19691	0.16019	0.15496	0.21748	0.18248
-25% dSPE	113/38/38	0.65534	0.60009	0.67634	0.56276	0.48515	0.59594

Table A.5. Summary of quantitative PAH (ng/g, dry wt) recoveries, std. deviation, and %RSD for the co-extractive clean-up study

PAH	Traditional dSPE								+25% dSPE								-25% dSPE							
	1	2	3	4	5	Avg.	StdDev	%RSD	1	2	3	4	5	Avg.	StdDev	%RSD	1	2	3	4	5	Avg.	StdDev	%RSD
Naphthalene	6.60	7.27	5.86	6.99	6.28	6.60	0.558	8.5	7.48	7.25	7.48	7.78	7.88	7.57	0.254	3.35	6.11	6.38	5.58	6.53	5.66	6.05	0.423	6.98
Benzothiophene	7.61	8.06	7.88	8.71	6.38	7.73	0.853	11.0	8.46	7.26	7.40	7.53	7.33	7.60	0.493	6.49	6.67	6.94	6.86	7.77	6.08	6.87	0.609	8.87
2-methylnaphthalene	7.71	9.52	6.58	8.62	6.34	7.75	1.35	17.4	7.69	8.75	7.28	8.88	6.48	7.82	1.011	12.9	6.88	8.35	5.91	7.37	5.56	6.81	1.13	16.5
1-methylnaphthalene-d10 SS#1	8.36	9.42	7.12	7.33	6.12	7.67	1.26	16.4	7.22	8.00	6.71	7.58	8.15	7.53	0.585	7.77	7.14	8.05	5.77	6.60	5.37	6.59	1.07	16.3
Biphenyl	6.94	8.85	7.81	6.96	7.33	7.58	0.796	10.5	7.63	7.35	7.83	6.63	6.43	7.17	0.617	8.60	6.48	8.12	7.23	6.32	6.60	6.95	0.738	10.6
2-ethylnaphthalene	8.78	7.51	6.75	7.07	5.67	7.16	1.13	15.8	7.51	7.28	7.91	7.21	7.66	7.51	0.286	3.80	7.91	7.02	5.32	6.73	5.07	6.41	1.20	18.7
Acenaphthylene	8.83	9.18	7.68	8.38	7.60	8.33	0.695	8.34	7.71	7.32	7.40	8.42	7.32	7.63	0.468	6.13	8.03	8.50	6.62	7.68	6.73	7.51	0.820	10.9
Acenaphthene	8.03	8.42	6.59	8.87	6.73	7.73	1.02	13.2	8.58	8.40	8.98	8.84	8.75	8.71	0.225	2.58	6.87	8.02	5.89	7.64	5.90	6.86	0.977	14.2
Dibenzofuran-d8 SS#2	8.07	10.1	7.16	9.00	7.19	8.30	1.25	15.0	7.70	7.54	8.32	8.01	7.78	7.87	0.303	3.85	6.67	8.69	6.19	8.04	6.79	7.27	1.05	14.4
Dibenzofuran	8.04	8.30	7.30	8.48	6.88	7.80	0.683	8.76	8.69	8.42	8.87	8.52	8.17	8.53	0.264	3.10	7.24	7.54	6.96	7.64	6.31	7.14	0.536	7.51
Fluorene	8.81	8.22	9.05	9.72	9.49	9.06	0.587	6.48	8.57	8.05	8.40	8.91	8.40	8.47	0.313	3.70	8.23	7.34	7.74	9.09	8.25	8.13	0.654	8.04
Dibenzothiophene	8.13	9.83	8.60	8.81	7.04	8.48	1.02	12.0	8.35	9.17	8.35	8.18	8.52	8.51	0.385	4.53	7.67	9.02	7.42	7.53	6.71	7.67	0.843	11.0
Phenanthrene	10.3	9.54	9.30	8.45	9.04	9.32	0.677	7.26	9.87	9.87	9.77	9.47	9.47	9.69	0.202	2.09	9.19	8.37	8.08	7.82	8.00	8.29	0.538	6.49
Anthracene-d10 SS#3	9.67	9.92	8.98	9.85	10.2	9.72	0.460	4.73	10.1	9.37	9.7	9.7	10.1	9.79	0.314	3.20	8.40	9.10	8.39	9.12	8.79	8.76	0.358	4.08
Anthracene	10.4	9.04	7.76	6.98	8.08	8.45	1.31	15.5	8.36	8.18	8.94	8.44	8.11	8.41	0.328	3.90	9.12	8.29	6.75	6.40	7.09	7.53	1.14	15.1
Carbozole	9.19	8.61	9.41	8.13	7.87	8.64	0.662	7.66	8.13	9.87	8.72	7.79	8.13	8.53	0.822	9.6	7.86	8.20	8.55	7.19	7.43	7.85	0.555	7.07
4-methylbenzothiophene	8.82	8.57	9.73	10.1	10.3	9.50	0.764	8.05	9.17	9.17	9.26	9.45	8.90	9.19	0.199	2.16	8.09	7.39	9.27	9.18	9.33	8.65	0.872	10.1
2-methylphenanthrene	8.53	10.0	7.28	6.70	8.08	8.13	1.29	15.8	9.81	9.32	9.22	10.3	9.71	9.67	0.430	4.44	7.68	8.89	6.80	6.38	7.48	7.45	0.961	12.9
2-methylanthracene	8.62	9.05	8.09	9.81	10.5	9.22	0.963	10.4	9.9	9.63	9.85	9.95	9.0	9.66	0.373	3.86	7.76	7.74	7.29	8.76	9.3	8.2	0.833	10.2
1-methylphenanthrene	9.30	9.11	9.04	8.71	9.75	9.18	0.385	4.19	8.71	10.30	8.10	8.97	8.80	8.98	0.810	9.02	8.16	7.93	8.37	7.91	8.63	8.20	0.306	3.73
3,6-dimethylphenanthrene	9.87	8.31	8.22	9.27	9.49	9.03	0.733	8.1	9.87	9.47	9.38	9.87	9.87	9.69	0.247	2.54	8.97	7.84	7.75	8.06	8.55	8.24	0.515	6.25
Fluoranthene	10.8	8.90	8.12	9.39	9.94	9.43	1.01	10.7	9.40	8.46	9.22	9.50	9.22	9.16	0.408	4.45	9.46	8.16	7.38	8.03	9.04	8.41	0.830	9.86
Pyrene	7.99	8.83	9.47	8.46	9.29	8.81	0.606	6.88	8.05	9.15	8.13	7.73	8.97	8.40	0.620	7.38	7.39	7.74	8.16	7.35	8.76	7.88	0.590	7.48
Benzo (a) fluorene	8.16	8.33	8.2	7.05	6.78	7.69	0.72	9.4	9.85	8.49	8.14	8.49	9.32	8.86	0.703	7.94	7.70	7.78	9.63	6.71	6.22	7.61	1.31	17.2
1-methylpyrene	9.41	9.13	8.68	9.55	10.1	9.36	0.509	5.43	8.79	8.98	8.53	9.35	8.88	8.90	0.301	3.38	9.03	8.01	7.61	8.68	8.74	8.42	0.584	6.94
Benzo (a) anthracene - d12 SS#	7.78	9.31	8.74	7.57	9.54	8.59	0.890	10.4	8.92	10.10	8.89	9.49	9.39	9.36	0.495	5.29	7.41	8.70	8.17	7.21	8.23	7.94	0.621	7.82
Benzo (a) anthracene	8.72	9.76	9.45	8.07	8.76	8.95	0.665	7.42	10.2	9.42	9.6	10.0	10.20	9.88	0.377	3.82	9.50	8.71	8.29	7.20	8.19	8.38	0.836	9.98
Chrysene	9.53	9.08	10.4	8.71	9.97	9.53	0.666	6.99	10.4	9.82	9.91	10.1	9.6	9.98	0.308	3.09	8.36	8.11	9.17	8.21	8.52	8.48	0.420	4.96
5-methylchrysene	9.11	9.18	8.34	10.7	11.0	9.66	1.13	11.7	9.51	8.93	8.84	9.89	9.70	9.37	0.467	4.98	8.68	8.42	7.79	9.66	9.8	8.9	0.847	9.55
Benzo (b) fluoranthene	7.29	7.99	8.99	8.70	9.18	8.43	0.783	9.3	10.2	9.62	10.1	9.92	9.72	9.92	0.254	2.56	6.88	7.40	8.03	7.70	8.50	7.70	0.617	8.01
Benzo (k) fluoranthene	8.60	9.52	9.01	7.27	9.75	8.83	0.978	11.1	9.35	9.86	8.97	9.07	9.25	9.30	0.346	3.72	8.11	8.28	8.34	6.93	8.79	8.09	0.695	8.59
Benzo (e) pyrene	10.1	8.86	10.5	9.00	9.86	9.65	0.693	7.18	9.71	9.13	9.91	9.71	8.94	9.48	0.422	4.46	8.82	7.57	9.02	9.12	9.21	8.75	0.675	7.71
Benzo (a) pyrene - d12 SS#5	8.68	8.54	8.43	8.81	9.21	8.73	0.300	3.44	9.37	9.07	8.99	9.56	9.46	9.29	0.246	2.65	8.27	7.43	7.96	8.23	8.5	8.08	0.417	5.16
Benzo (a) Pyrene	8.44	7.75	8.68	8.66	10.6	8.83	1.06	12.1	9.15	9.87	9.34	8.88	8.97	9.24	0.392	4.25	7.89	7.31	8.04	7.47	9.31	8.00	0.787	9.83
Perylene	7.57	7.54	9.30	7.58	7.27	7.85	0.819	10.4	9.08	9.52	8.86	9.26	9.17	9.18	0.242	2.64	6.64	7.18	8.69	6.89	6.61	7.20	0.863	12.0
Indeno (1,2,3 - cd) pyrene	9.39	8.72	9.72	8.94	8.80	9.12	0.426	4.68	8.97	8.59	8.88	8.52	8.97	8.79	0.216	2.45	8.10	7.58	8.84	7.77	7.93	8.04	0.482	5.99
Dibenzo (a,h) anthracene	7.54	9.36	8.58	7.79	9.47	8.55	0.882	10.3	8.67	8.07	8.85	8.33	8.85	8.55	0.345	4.03	6.73	8.21	7.59	7.35	8.46	7.67	0.690	9.00
Benzo (g,h,i) perylene	8.09	7.93	7.77	8.72	8.59	8.22	0.417	5.07	8.43	8.17	8.09	8.01	7.92	8.12	0.194	2.38	7.09	6.89	7.19	8.30	7.95	7.49	0.608	8.12
Avg. total PAH recovery (%)						85.7								88.0								77.5		

Table A.6. PAH (ng/g, dry wt) quantitative results for the enhanced and traditional extraction protocol comparison

PAH	Enhanced QuEChERS method						Traditional QuEChERS method						% change
	1	2	3	Avg.	StdDev	%RSD	1	2	3	Avg.	StdDev	%RSD	
Naphthalene	7.38	8.11	8.48	7.99	0.561	7.02	9.19	8.69	8.37	8.75	0.413	4.71	
Benzothiophene	8.58	8.89	7.82	8.43	0.553	6.56	8.54	7.25	7.62	7.80	0.662	8.49	
2-methylnaphthalene	8.18	7.85	8.40	8.14	0.275	3.38	7.90	7.52	7.97	7.80	0.242	3.11	
1-methylnaphthalene-d10 SS#1	7.69	8.61	7.41	7.90	0.628	7.94	8.66	8.33	8.01	8.33	0.322	3.86	
Biphenyl	8.66	8.43	8.42	8.50	0.135	1.59	8.87	8.34	8.02	8.41	0.434	5.16	
2-ethylnaphthalene	8.57	8.97	7.80	8.45	0.595	7.05	8.18	8.85	8.72	8.58	0.356	4.15	
2-ring avg. PAH recovery (%)				82.4						82.8			-0.53
Acenaphthylene	9.07	9.35	10.2	9.54	0.582	6.10	7.06	7.35	7.35	7.26	0.167	2.30	
Acenaphthene	9.63	9.35	8.99	9.32	0.317	3.40	7.49	7.29	7.15	7.31	0.171	2.34	
Dibenzofuran-d8 SS#2	9.59	8.97	8.64	9.07	0.482	5.32	8.34	7.29	7.84	7.82	0.525	6.71	
Dibenzofuran	10.7	10.0	9.27	9.98	0.702	7.04	8.80	7.30	7.06	7.72	0.942	12.2	
Fluorene	8.68	8.76	8.90	8.78	0.111	1.26	7.98	7.68	7.17	7.61	0.410	5.38	
Dibenzothiophene	9.18	9.71	10.8	9.89	0.815	8.24	8.68	7.52	6.97	7.72	0.873	11.3	
Phenanthrene	8.82	9.17	8.15	8.71	0.519	5.96	7.94	7.34	7.03	7.44	0.463	6.22	
Anthracene-d10 SS#3	8.25	7.83	7.97	8.02	0.215	2.68	7.48	7.63	7.20	7.44	0.223	2.99	
Anthracene	9.41	9.98	10.1	9.82	0.359	3.66	7.72	7.81	7.12	7.55	0.375	4.97	
Carbozole	10.2	9.21	10.4	10.0	0.662	6.64	7.29	6.87	7.05	7.07	0.211	2.98	
4-methylbenzothiophene	8.99	8.50	9.59	9.03	0.545	6.04	8.42	7.49	7.66	7.86	0.496	6.31	
2-methylphenanthrene	8.42	8.89	8.55	8.62	0.241	2.80	8.07	7.29	7.59	7.65	0.393	5.14	
2-methylanthracene	9.57	9.55	8.67	9.26	0.514	5.55	7.74	6.99	7.64	7.46	0.41	5.45	
1-methylphenanthrene	8.98	8.64	8.03	8.55	0.483	5.65	8.14	7.21	7.78	7.71	0.469	6.08	
3,6-dimethylphenanthrene	10.6	9.90	10.4	10.3	0.359	3.49	7.64	7.69	6.76	7.36	0.522	7.09	
3-ring avg. PAH recovery (%)				92.6						75.3			22.9
Fluoranthene	8.72	8.78	9.49	9.00	0.425	4.73	7.24	7.70	6.81	7.25	0.445	6.14	
Pyrene	9.53	8.64	8.98	9.05	0.449	4.97	7.03	7.34	7.73	7.37	0.349	4.74	
Benzo (a) fluorene	8.81	8.73	9.12	8.89	0.206	2.32	7.46	7.71	6.20	7.12	0.809	11.4	
1-methylpyrene	9.23	9.22	8.68	9.04	0.317	3.50	7.69	7.15	7.39	7.41	0.272	3.67	
Benzo (a) anthracene - d12 SS#4	8.62	8.25	8.98	8.62	0.364	4.23	7.99	7.13	6.61	7.24	0.697	9.62	
Benzo (a) anthracene	9.04	9.75	9.07	9.29	0.400	4.31	7.45	7.71	6.23	7.13	0.790	11.1	
Chrysene	9.68	10.1	9.99	9.93	0.222	2.24	7.19	7.36	6.89	7.15	0.238	3.33	
5-methylchrysene	8.55	9.78	9.14	9.16	0.615	6.72	7.86	7.70	6.95	7.50	0.484	6.45	
4-ring avg. PAH recovery (%)				91.8						73.0			25.8
Benzo (b) fluoranthene	8.66	9.21	8.79	8.89	0.292	3.28	7.75	6.54	5.88	6.72	0.95	14.1	
Benzo (k) fluoranthene	8.82	9.15	9.89	9.29	0.551	5.94	7.25	7.15	6.57	6.99	0.367	5.26	
Benzo (e) pyrene	8.54	8.22	9.48	8.74	0.653	7.47	7.47	6.69	7.01	7.06	0.390	5.52	
Benzo (a) pyrene - d12 SS#5	8.66	8.43	8.37	8.48	0.155	1.82	7.24	7.65	6.44	7.11	0.615	8.66	
Benzo (a) Pyrene	9.08	8.45	8.28	8.60	0.419	4.87	6.96	7.04	6.17	6.72	0.480	7.15	
Perylene	8.16	8.82	8.94	8.64	0.422	4.89	6.86	6.27	6.34	6.49	0.318	4.89	
5-ring avg. PAH recovery (%)				88.2						69.3			27.2
Indeno (1,2,3 - cd) pyrene	8.64	8.55	8.41	8.53	0.118	1.38	6.39	6.20	6.33	6.31	0.094	1.49	
Dibenzo (a,h) anthracene	8.91	8.54	7.99	8.48	0.464	5.47	6.18	6.65	5.76	6.20	0.447	7.22	
Benzo (g,h,i) perylene	8.68	8.56	7.79	8.35	0.482	5.77	6.32	6.52	6.49	6.44	0.112	1.73	
6-ring avg. PAH recovery (%)				84.5						63.2			33.8

Table A.7. Summary of the PAH (µg/Kg, dry weight) content in diploid oysters during summer exposure study.

Name	Water Control Treatment																							
	Week 0			Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Naphthalene	1.72	1.44	1.77	1.56	1.33	1.62	2.10	1.29	2.13	1.53	1.18	1.57	1.33	1.14	1.48	1.25	0.98	1.33	1.20	0.78	1.12	0.98	0.68	0.98
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	2.39	2.40	2.20	2.21	2.18	2.02	2.67	2.58	2.30	2.31	2.69	1.94	2.40	2.04	1.55	1.85	1.79	1.75	1.84	1.54	1.59	1.41	1.39	1.48
Biphenyl	0.70	0.83	0.76	0.64	0.79	0.69	0.64	0.97	0.68	0.61	0.79	0.59	0.49	0.69	0.63	0.49	0.66	0.64	0.33	0.55	0.51	0.34	0.52	0.59
2-ethylnaphthalene	1.69	1.46	1.91	1.54	1.38	1.77	1.68	1.85	1.93	1.63	1.29	1.66	1.41	1.17	1.33	1.56	0.89	1.30	1.50	0.83	1.13	1.21	0.91	0.95
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	1.61	1.34	1.47	1.50	1.25	1.36	1.56	1.40	1.61	1.69	1.25	1.62	1.38	1.00	1.22	1.28	0.93	1.03	1.00	0.81	1.02	0.87	0.75	0.89
Dibenzofuran	1.53	1.57	1.79	1.46	1.50	1.62	1.46	1.30	1.86	1.05	1.14	1.69	0.90	1.07	1.47	1.00	1.05	1.18	0.87	0.82	1.11	0.88	0.87	1.21
Fluorene	1.57	1.39	1.54	1.43	1.33	1.45	1.42	1.52	1.41	1.58	1.32	1.61	1.05	1.37	1.37	1.14	1.12	1.20	0.91	0.99	1.12	0.82	0.89	1.02
Dibenzothiophene	1.66	1.64	1.69	1.54	1.56	1.59	1.69	1.48	1.56	1.66	1.50	1.73	1.65	1.31	1.22	1.36	1.48	1.25	1.14	1.36	1.07	1.08	1.26	0.79
Phenanthrene	2.06	2.42	2.24	1.91	2.28	2.04	2.02	2.50	2.36	2.17	2.33	1.66	2.16	1.69	1.35	1.89	1.69	1.21	1.50	1.46	1.16	1.37	1.47	1.18
Anthracene	2.82	2.42	2.33	2.56	2.26	2.20	2.91	2.49	2.53	2.41	2.32	2.67	1.77	1.82	2.15	1.89	2.03	1.83	2.00	1.52	1.74	1.64	1.79	1.56
Carbozole	1.55	1.63	1.74	1.44	1.50	1.60	1.80	1.38	2.18	1.54	1.58	1.56	1.62	1.18	1.68	1.39	1.43	1.37	1.21	1.22	1.35	1.28	1.20	1.11
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	1.61	1.54	1.60	1.50	1.43	1.49	1.74	1.86	2.10	1.36	1.60	1.66	1.18	1.68	1.54	1.28	1.28	1.54	1.12	1.45	1.27	1.04	1.14	1.31
2-methylanthracene	0.75	0.78	0.74	0.70	0.73	0.67	0.76	0.73	0.66	0.63	0.73	0.68	0.64	0.70	0.66	0.60	0.63	0.61	0.49	0.58	0.50	0.46	0.58	0.55
1-methylphenanthrene	0.95	0.66	0.74	0.88	0.63	0.69	1.01	0.82	0.82	0.71	0.68	0.70	0.70	0.56	0.64	0.58	0.49	0.57	0.57	0.35	0.54	0.51	0.33	0.48
3,6-dimethylphenanthrene	1.24	1.57	1.94	1.19	1.48	1.78	1.37	1.23	1.52	1.40	1.48	1.23	1.00	0.99	1.14	1.05	0.79	0.96	1.01	0.76	0.95	0.96	0.76	0.85
Fluoranthene	0.88	0.75	0.73	0.80	0.69	0.68	0.83	0.67	0.61	0.88	0.56	0.66	0.70	0.49	0.60	0.61	0.59	0.46	0.61	0.53	0.47	0.50	0.53	0.33
Pyrene	1.43	1.59	1.63	1.35	1.49	1.50	1.90	1.82	1.75	1.58	1.65	1.70	1.49	1.18	1.27	1.18	1.24	1.10	1.13	1.05	1.09	1.10	1.03	0.88
Benzo (a) fluorene	0.85	0.83	0.77	0.78	0.79	0.71	0.92	0.91	0.91	0.73	0.72	0.84	0.63	0.54	0.67	0.62	0.60	0.59	0.47	0.48	0.68	0.51	0.54	0.49
1-methylpyrene	1.79	1.42	1.38	1.70	1.32	1.26	2.09	1.59	1.40	1.77	1.35	1.09	1.63	1.18	1.20	1.36	1.09	1.19	1.12	1.13	1.01	1.33	1.14	0.93
Benzo (a) anthracene	2.42	2.66	2.69	2.31	2.44	2.54	3.01	2.66	2.74	2.03	2.12	2.73	2.32	2.13	1.77	1.92	1.85	1.75	1.89	1.80	1.50	2.03	1.56	1.42
Chrysene	2.16	2.14	2.19	2.05	2.02	2.03	2.67	2.80	2.10	2.10	2.94	1.85	1.65	2.37	1.76	1.58	2.26	1.40	1.46	2.23	1.22	1.45	2.18	1.05
5-methylchrysene	1.76	1.27	1.62	1.65	1.18	1.51	2.09	1.76	1.66	2.11	1.49	1.86	1.85	1.34	1.48	1.86	1.06	1.60	1.61	1.07	1.36	1.60	1.00	1.16
Benzo (b) fluoranthene	0.97	0.69	0.73	0.89	0.66	0.67	0.85	0.74	0.77	0.90	0.57	0.59	0.76	0.51	0.59	0.60	0.56	0.55	0.59	0.49	0.49	0.49	0.56	0.41
Benzo (k) fluoranthene	1.82	1.62	1.29	1.70	1.48	1.22	1.91	1.21	1.48	1.26	1.17	1.22	1.07	1.06	1.05	1.21	0.75	1.04	0.95	0.77	0.97	0.90	0.62	0.83
Benzo (e) pyrene	0.79	0.88	0.83	0.72	0.81	0.76	0.67	0.80	0.82	0.55	0.70	0.79	0.46	0.62	0.69	0.50	0.56	0.63	0.47	0.61	0.65	0.42	0.52	0.62
Benzo (a) Pyrene	0.86	0.84	0.79	0.81	0.77	0.74	0.92	0.73	0.95	0.72	0.75	1.02	0.58	0.68	0.84	0.51	0.47	0.69	0.51	0.50	0.58	0.58	0.35	0.52
Perylene	1.51	1.55	1.28	1.37	1.44	1.17	1.58	1.67	1.63	1.51	1.38	1.40	1.32	1.01	1.11	1.30	1.03	1.09	1.10	0.89	1.00	1.06	1.06	0.99
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	41.1	39.3	40.4	38.2	36.7	37.4	44.3	40.8	42.5	38.4	37.3	38.3	34.1	31.5	32.5	31.9	29.3	29.9	28.6	26.6	27.2	26.8	25.6	24.6

Table A.7. Summary of the PAH (μg/Kg, dry weight) content in diploid oysters during summer exposure study (continued).

	Sediemnt Control Treatment																				
	Week			Week			Week			Week			Week			Week			Week		
Name	1			2			3			4			5			6			7		
Naphthalene	4.37	3.60	4.54	2.50	1.49	2.53	1.82	1.40	1.81	1.59	1.32	1.74	1.44	1.17	1.54	1.39	0.91	1.33	1.13	0.79	1.15
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	2.55	2.62	3.34	3.13	2.97	2.65	2.75	3.23	4.31	4.88	2.41	1.83	2.15	2.07	2.10	2.14	1.84	2.86	1.64	1.64	1.77
Biphenyl	0.74	0.92	0.82	3.74	1.16	0.81	0.70	0.93	0.71	0.58	0.82	0.75	0.57	0.76	0.74	0.40	0.66	0.60	0.39	0.60	0.71
2-ethylnaphthalene	1.77	1.66	2.10	1.98	2.15	2.26	1.91	1.48	1.97	1.64	1.39	1.57	1.81	1.05	1.55	1.78	1.00	1.35	1.42	1.09	1.11
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	1.78	1.49	1.60	1.85	1.68	1.87	2.01	1.50	1.94	1.60	1.18	1.46	3.49	1.07	1.19	1.18	0.95	1.21	1.00	0.87	1.05
Dibenzofuran	1.75	1.75	1.93	3.73	1.56	2.20	1.23	1.34	5.94	1.08	1.26	1.76	1.19	1.22	1.38	1.04	0.96	2.30	1.03	1.03	1.43
Fluorene	1.65	1.54	2.72	1.67	1.80	1.64	1.88	1.52	1.91	3.22	1.63	1.58	1.36	1.32	1.41	1.07	1.15	1.32	0.95	1.06	1.19
Dibenzothiophene	1.78	1.88	1.88	2.01	1.76	1.84	1.93	1.74	2.06	1.95	1.51	1.45	1.56	1.70	1.43	1.33	1.58	1.23	1.29	1.46	0.91
Phenanthrene	2.23	2.62	2.41	2.42	2.95	2.71	2.58	2.75	1.96	2.52	1.97	1.58	2.23	1.96	1.43	1.77	1.72	1.35	1.58	1.72	1.38
Anthracene	2.95	2.66	2.64	5.38	2.94	2.90	2.89	2.71	5.21	4.06	2.09	2.55	2.21	2.37	2.12	2.38	1.75	4.02	1.91	2.08	1.79
Carbozole	1.69	1.72	1.88	2.13	1.61	2.61	1.82	1.85	1.81	1.93	1.42	1.96	2.64	1.70	1.58	1.40	1.45	1.58	1.47	1.42	1.32
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	1.78	1.66	1.71	2.08	2.18	2.45	1.61	1.87	1.93	1.37	2.00	1.84	1.53	1.50	1.78	1.31	1.71	1.46	1.22	1.31	1.50
2-methylanthracene	0.83	0.85	2.78	0.89	0.84	0.76	0.75	0.86	0.79	2.77	0.84	0.78	3.69	0.74	0.73	0.58	0.67	0.57	0.55	0.69	0.64
1-methylphenanthrene	1.02	0.72	0.81	1.20	0.97	0.95	0.85	0.79	2.82	0.80	0.65	0.77	0.69	0.58	0.68	0.66	0.41	0.63	0.60	0.38	0.56
3,6-dimethylphenanthrene	1.38	1.76	2.09	1.57	1.42	1.83	1.67	1.76	1.47	1.20	1.14	1.37	1.24	0.91	1.12	1.16	0.91	2.10	1.11	0.90	1.01
Fluoranthene	0.96	0.81	0.79	0.98	0.80	0.71	1.06	0.65	0.78	0.82	0.57	0.72	2.72	0.69	0.54	0.72	0.62	1.54	0.58	0.61	0.38
Pyrene	1.56	1.79	1.77	2.24	2.18	2.09	1.86	1.95	1.95	1.77	1.37	1.49	1.37	1.43	1.29	1.34	1.25	1.28	1.29	1.23	1.03
Benzo (a) fluorene	0.93	0.92	0.82	1.10	1.09	1.05	0.87	0.84	1.00	0.75	0.62	0.78	0.75	0.71	0.70	0.54	0.56	1.82	0.60	0.63	0.58
1-methylpyrene	1.99	1.52	1.45	2.48	1.91	1.67	2.09	1.57	1.30	1.95	1.38	1.43	1.63	1.28	1.39	1.29	1.32	1.20	1.57	1.31	1.07
Benzo (a) anthracene	2.68	2.80	3.05	3.49	3.11	3.15	2.39	2.54	3.25	2.76	2.54	2.11	2.24	2.12	2.05	2.25	2.10	1.80	2.44	1.83	1.66
Chrysene	2.46	2.36	4.44	3.07	3.34	2.52	2.43	3.44	2.15	2.89	2.85	2.09	1.86	2.62	1.62	1.73	2.68	1.42	1.71	2.51	1.21
5-methylchrysene	1.93	1.35	1.75	2.42	2.08	1.95	2.53	1.76	2.17	2.19	1.60	1.76	2.17	1.22	1.84	1.93	1.25	1.62	1.90	1.20	1.37
Benzo (b) fluoranthene	1.04	0.78	0.79	3.00	0.88	0.91	1.03	0.68	0.68	0.91	0.61	0.71	0.69	0.66	0.64	0.67	0.57	1.56	0.58	0.67	0.47
Benzo (k) fluoranthene	2.01	1.72	1.47	4.29	1.41	1.77	1.50	1.39	1.44	1.27	1.22	1.22	1.45	0.87	1.24	1.14	0.90	1.15	1.08	0.71	0.99
Benzo (e) pyrene	0.85	0.97	0.91	0.78	0.95	0.97	0.66	0.83	0.92	0.53	0.71	0.81	0.57	0.67	0.76	0.54	0.72	0.77	0.50	0.61	0.75
Benzo (a) Pyrene	0.93	0.90	0.88	1.06	0.87	1.13	0.84	0.87	1.17	0.69	0.78	1.00	0.60	0.56	0.80	0.61	0.60	0.69	0.66	0.42	0.61
Perylene	1.63	1.68	2.39	1.82	1.93	1.95	1.78	1.60	1.66	1.54	1.17	1.31	1.50	1.22	1.25	1.26	1.06	1.19	1.27	1.27	1.15
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	47.2	45.0	53.7	63.0	48.0	49.9	45.4	43.9	55.1	49.3	37.0	38.4	45.4	34.2	34.9	33.6	31.3	40.0	31.5	30.0	28.8

Table A.7. Summary of the PAH (µg/Kg, dry weight) content in diploid oysters during summer exposure study (continued).

	500 ppm Treatment																				
	Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Name																					
Naphthalene	24.7	29.6	23.4	39.2	36.3	38.4	21.2	20.3	20.4	19.2	17.8	15.4	13.7	15.2	16.9	13.2	11.5	10.8	8.51	6.24	5.72
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	12.5	18.1	12.7	20.4	23.5	18.7	11.4	21.5	10.8	8.99	11.7	7.65	7.36	20.1	6.90	6.21	5.48	4.54	4.01	3.87	4.11
Biphenyl	4.91	5.00	5.62	7.01	7.35	8.38	6.45	6.69	7.80	4.91	4.93	5.36	3.71	3.97	4.44	13.2	3.16	3.69	2.59	2.57	3.02
2-ethylnaphthalene	11.1	6.90	11.7	17.9	11.3	19.1	16.5	10.1	17.0	11.8	7.13	12.8	9.51	6.11	10.7	7.89	5.66	7.83	7.18	4.07	8.60
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	10.4	8.94	9.66	17.0	14.6	14.0	14.8	13.5	12.9	11.6	9.67	9.66	9.69	18.5	7.00	6.97	7.18	6.44	6.46	5.27	4.90
Dibenzofuran	9.33	9.70	8.77	13.7	12.7	14.1	12.2	11.2	12.2	9.33	7.30	8.91	7.41	7.63	7.21	6.59	5.34	6.50	4.80	15.0	6.36
Fluorene	8.90	8.22	10.0	14.8	13.7	14.9	13.0	11.8	13.7	9.93	8.36	9.26	8.01	7.81	7.47	16.1	6.58	6.72	6.52	5.35	5.38
Dibenzothiophene	12.6	18.1	9.86	18.0	12.4	14.5	16.7	11.4	13.5	12.6	7.83	10.0	9.17	6.96	7.68	7.37	5.47	6.96	8.09	5.47	6.52
Phenanthrene	12.8	16.7	16.1	20.4	27.8	24.3	18.3	24.7	21.9	13.0	17.5	15.3	12.0	13.9	12.9	8.55	13.3	10.9	7.73	11.7	9.49
Anthracene	16.2	15.7	15.8	24.5	23.1	26.3	22.5	20.8	23.2	17.1	16.2	17.9	13.5	13.9	15.0	12.2	9.26	11.8	10.3	10.4	10.8
Carbozole	10.2	7.83	12.6	16.0	23.1	20.4	14.0	11.2	18.1	11.0	18.0	12.4	9.10	18.3	12.2	7.82	6.27	9.58	5.59	5.88	7.75
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	9.60	11.6	7.18	15.0	17.1	10.3	13.1	15.0	9.2	9.75	12.0	6.67	8.25	8.89	5.54	7.35	8.03	4.92	6.60	7.52	4.21
2-methylanthracene	5.07	4.31	3.50	7.93	7.00	5.31	6.90	6.05	4.83	5.47	4.31	3.45	4.28	13.5	2.97	13.3	2.99	2.39	2.93	12.8	2.18
1-methylphenanthrene	6.76	15.0	5.73	9.80	7.63	8.55	8.82	6.95	7.87	6.37	14.7	5.22	5.00	4.35	4.53	4.12	3.66	3.42	3.43	3.36	3.59
3,6-dimethylphenanthrene	9.23	10.0	13.0	13.4	15.4	19.7	11.6	14.0	17.7	8.30	10.8	13.2	7.76	9.09	10.8	5.62	7.24	9.05	5.75	6.32	6.89
Fluoranthene	6.17	13.9	5.13	10.3	6.23	7.54	9.57	15.7	6.48	7.20	4.30	4.67	5.87	13.1	4.07	4.63	3.12	3.77	4.22	2.37	3.09
Pyrene	8.58	10.1	9.53	13.8	15.3	14.4	12.7	13.3	12.6	8.30	9.80	9.38	7.89	7.97	8.08	6.78	7.51	5.77	5.53	6.59	6.35
Benzo (a) fluorene	6.34	6.13	4.64	9.76	9.15	7.49	8.88	8.32	6.44	6.54	15.7	4.64	5.27	4.76	4.12	14.2	4.21	3.52	4.39	13.6	3.37
1-methylpyrene	9.17	7.23	6.34	14.3	12.1	10.2	12.8	10.7	9.21	8.60	8.20	6.24	7.16	7.11	5.83	6.30	5.42	4.30	5.73	4.82	4.20
Benzo (a) anthracene	13.3	15.8	16.0	18.9	23.3	25.4	17.2	20.7	23.4	13.3	15.8	16.5	10.8	12.6	13.5	7.95	11.2	12.5	6.82	8.15	10.9
Chrysene	11.2	26.1	10.4	18.4	14.8	15.2	16.9	22.1	14.0	11.8	16.9	10.2	10.9	14.6	7.62	8.84	10.2	6.55	8.29	10.2	5.49
5-methylchrysene	12.2	6.03	8.18	19.1	19.9	12.8	17.4	18.6	11.5	11.7	6.92	8.18	10.5	5.14	7.28	8.42	4.85	6.39	7.08	4.35	4.47
Benzo (b) fluoranthene	5.58	3.42	4.28	8.45	5.35	6.39	7.86	4.71	5.75	5.83	13.2	4.09	4.65	13.2	3.20	4.23	2.30	2.94	3.30	12.0	2.24
Benzo (k) fluoranthene	9.34	20.4	8.55	14.4	16.3	12.2	13.4	15.1	10.7	9.49	9.92	7.82	8.19	9.44	7.08	7.04	6.83	5.37	5.89	7.32	5.37
Benzo (e) pyrene	5.11	6.56	4.67	8.37	9.65	6.77	7.62	19.0	5.89	5.28	6.56	4.67	4.44	5.60	3.59	13.7	4.82	2.84	3.52	3.86	2.44
Benzo (a) Pyrene	5.41	9.40	5.84	8.07	7.83	8.34	7.43	6.72	7.67	5.49	5.68	5.84	4.36	3.91	4.17	3.55	3.28	3.84	3.63	3.44	3.09
Perylene	11.7	10.7	7.75	17.1	6.35	11.1	15.1	19.7	9.52	11.3	11.2	6.98	9.94	8.48	6.42	8.23	8.00	5.09	7.54	7.04	4.76
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	268	322	257	416	399	395	354	380	334	264	292	242	218	274	207	230	173	168	156	190	145

Table A.7. Summary of the PAH (µg/Kg, dry weight) content in diploid oysters during summer exposure study (continued).

	5000 ppm Treatment																				
	Week			Week			Week			Week			Week			Week			Week		
Name	1			2			3			4			5			6			7		
Naphthalene	77.6	89.6	108	118	138	146	59.9	75.8	77.4	50.5	62.0	54.1	35.3	34.5	46.7	30.5	32.1	24.1	25.4	14.5	16.8
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	53.4	54.2	47.7	79.7	82.2	67.2	59.6	37.8	37.0	31.9	36.2	26.9	25.5	21.4	16.8	21.9	16.4	16.9	15.4	11.4	16.5
Biphenyl	17.2	15.7	29.1	24.5	22.8	28.5	23.1	20.3	25.4	17.4	45.0	18.5	11.8	12.5	14.2	9.81	8.89	10.8	8.58	7.75	7.69
2-ethylnaphthalene	37.8	31.0	49.2	55.6	43.0	74.5	60.1	39.1	65.6	36.7	31.8	49.2	25.0	21.5	38.0	23.4	17.2	26.8	27.8	12.0	24.6
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	45.9	32.5	35.2	62.9	43.9	51.8	57.9	40.9	48.2	40.9	32.1	34.2	49.3	22.4	24.9	22.0	17.6	19.2	20.8	13.2	15.5
Dibenzofuran	33.6	29.0	29.8	46.7	43.3	43.8	44.3	40.7	41.2	30.8	29.8	32.4	21.5	22.1	19.7	36.8	15.6	17.5	11.7	12.1	12.7
Fluorene	43.4	35.4	35.5	57.8	52.1	52.3	52.6	47.4	46.0	40.5	34.4	37.6	26.0	26.6	24.6	26.0	19.3	18.8	24.6	18.2	13.1
Dibenzothiophene	43.9	33.9	33.4	59.3	48.5	46.4	53.4	45.6	43.1	41.5	53.2	34.8	28.5	21.8	24.6	21.9	17.9	17.2	19.6	12.6	15.8
Phenanthrene	39.7	70.5	65.5	61.1	108	94.9	56.8	95.4	84.4	39.7	79.2	61.7	28.1	51.0	45.5	24.4	40.1	42.7	21.4	36.9	32.3
Anthracene	55.6	58.3	60.6	78.3	83.3	84.2	74.4	74.2	74.1	58.7	58.3	54.7	37.6	42.5	45.5	35.2	36.7	33.7	21.1	28.3	27.8
Carbozole	34.7	37.2	45.7	51.1	50.9	67.3	55.0	47.4	60.5	37.3	37.7	45.7	28.1	27.0	35.0	49.2	17.8	24.9	17.9	15.3	19.5
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	32.9	45.5	25.0	45.0	63.2	33.8	41.0	56.3	31.1	32.0	46.2	24.0	44.8	28.5	16.2	18.0	22.1	12.2	15.3	18.3	10.2
2-methylanthracene	19.9	14.9	34.6	27.0	23.0	20.2	24.3	21.3	17.7	19.9	35.8	13.3	14.6	12.4	9.28	11.6	9.64	7.87	19.7	7.57	5.45
1-methylphenanthrene	24.0	15.6	20.1	35.3	22.9	29.9	33.2	20.4	26.3	24.3	15.3	21.5	16.9	12.1	14.7	14.1	9.39	11.1	11.6	6.64	10.5
3,6-dimethylphenanthrene	36.5	32.9	44.3	52.2	47.8	59.1	45.9	42.0	55.5	38.6	34.4	44.3	24.0	21.5	28.9	23.0	18.1	23.6	16.2	14.3	14.8
Fluoranthene	21.7	14.1	27.4	32.9	19.3	25.6	40.3	17.2	23.8	24.7	12.9	17.7	35.4	8.70	13.8	32.5	7.73	10.8	11.5	6.38	7.95
Pyrene	27.8	40.2	38.5	41.5	53.6	52.0	37.4	48.8	47.3	30.7	40.2	37.9	22.0	29.5	27.5	15.4	24.1	22.3	19.7	13.9	16.1
Benzo (a) fluorene	26.7	22.0	28.8	37.1	29.3	25.5	34.1	26.9	22.9	25.6	40.2	17.8	28.9	15.5	14.0	16.7	10.2	9.17	12.6	7.90	6.37
1-methylpyrene	35.5	28.6	25.7	47.3	39.8	37.9	43.0	35.8	33.3	31.2	28.6	27.6	23.2	18.7	18.9	38.2	15.1	15.5	14.7	11.9	12.9
Benzo (a) anthracene	46.4	48.3	54.2	68.2	72.2	76.3	60.0	68.6	71.0	45.0	49.1	51.9	36.8	39.7	34.4	30.7	26.0	29.8	19.1	18.8	23.7
Chrysene	42.2	52.3	42.3	57.1	79.3	56.4	50.8	69.8	51.9	38.2	59.5	41.2	29.7	43.6	28.8	24.5	34.9	23.1	14.3	19.8	19.7
5-methylchrysene	48.1	25.3	41.3	65.0	36.6	44.7	61.1	32.9	40.7	46.8	46.0	30.9	29.9	17.2	21.5	26.0	14.3	17.9	20.8	12.1	11.6
Benzo (b) fluoranthene	20.1	13.6	13.8	29.6	18.2	19.2	36.9	16.7	17.1	20.4	13.3	12.7	29.7	9.64	10.4	21.5	7.28	6.71	19.4	5.28	5.75
Benzo (k) fluoranthene	35.6	35.8	46.0	53.2	50.4	36.6	50.5	46.9	34.4	38.3	56.3	23.8	27.1	22.7	19.1	18.6	21.2	15.8	18.1	15.1	11.0
Benzo (e) pyrene	17.4	21.4	23.2	26.0	28.9	20.3	33.6	26.1	18.5	17.1	18.8	14.4	13.2	15.6	9.95	9.86	11.9	7.72	17.1	8.10	5.89
Benzo (a) Pyrene	20.1	16.7	22.5	28.2	24.2	31.7	25.7	22.8	29.5	19.2	17.9	23.8	34.5	10.9	14.9	12.7	8.72	13.6	7.91	6.06	9.19
Perylene	39.6	40.3	23.7	58.3	56.0	34.3	51.9	52.6	30.2	43.7	37.0	25.1	26.2	25.8	15.8	24.5	21.8	15.1	19.8	19.0	9.27
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	977	955	1051	1398	1381	1360	1267	1170	1154	922	1051	878	754	635	634	639	502	495	472	374	383

Table A.7. Summary of the PAH (µg/Kg, dry weight) content in diploid oysters during summer exposure study (continued).

	25000 ppm Treatment																				
	Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Name																					
Naphthalene	139	143	161	188	207	234	84.6	105	124	63.9	70.3	81.8	60.2	62.0	58.4	43.5	40.2	51.4	40.2	22.0	28.5
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	90.5	64.1	71.5	128	98.6	101	66.3	26.3	47.4	39.5	21.6	39.3	24.4	24.7	28.5	19.5	21.6	19.3	14.4	24.7	21.2
Biphenyl	22.3	21.0	25.6	31.9	49.6	37.0	29.0	36.5	33.3	22.3	23.1	26.7	16.6	13.9	18.9	21.5	18.9	14.4	8.29	7.41	32.4
2-ethylnaphthalene	60.0	44.2	71.7	77.9	55.9	96.8	74.0	72.3	86.2	57.6	61.2	76.5	39.7	26.8	43.6	30.4	19.6	36.8	20.2	15.1	31.0
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	59.0	44.8	51.5	88.1	65.9	72.6	82.8	58.0	64.6	65.2	48.8	52.2	46.7	19.5	35.6	33.5	25.5	21.8	22.9	21.8	21.0
Dibenzofuran	51.6	40.5	41.7	65.3	76.0	61.4	58.1	45.7	58.3	47.0	58.3	43.6	35.9	24.9	28.2	20.2	17.1	19.6	22.2	18.2	28.4
Fluorene	47.9	61.7	52.7	69.4	83.3	73.2	63.1	95.0	68.1	55.5	62.5	53.4	38.2	40.8	35.1	24.3	27.6	24.2	19.4	21.7	21.2
Dibenzothiophene	57.1	46.6	41.6	77.1	63.0	60.3	68.6	59.2	56.1	60.9	44.1	42.8	36.2	30.9	33.2	48.5	24.6	19.3	26.2	16.4	29.6
Phenanthrene	65.4	98.7	85.4	97.7	152	114	89.9	134	104	71.3	118	82.0	50.8	47.6	54.6	29.3	23.8	39.8	29.3	50.1	39.8
Anthracene	71.4	84.0	83.2	94.0	117	109	84.6	103	97.4	71.4	108	87.6	44.2	53.7	51.4	29.1	34.2	37.2	31.0	31.5	31.7
Carbozole	62.9	60.3	73.5	81.7	96.4	94.2	73.6	71.8	83.8	58.8	58.8	72.5	41.7	40.5	44.3	25.3	23.7	37.7	25.3	22.9	29.2
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	41.0	59.2	37.1	58.5	82.2	50.8	55.0	76.5	44.7	44.5	77.6	37.6	29.3	17.5	26.9	20.5	25.4	18.8	19.3	23.0	25.7
2-methylanthracene	25.2	27.5	16.5	32.3	56.8	24.2	30.1	52.8	23.0	23.0	26.1	18.9	17.8	19.1	11.1	20.3	21.7	7.26	10.4	12.9	16.5
1-methylphenanthrene	38.5	28.9	34.1	49.4	36.6	44.9	45.9	42.3	42.2	36.6	48.3	35.0	23.7	17.2	22.9	15.8	24.8	16.2	12.3	12.8	15.3
3,6-dimethylphenanthrene	66.8	47.5	65.5	83.5	66.9	88.6	74.3	62.8	83.3	66.8	51.5	63.8	41.8	24.8	45.2	28.4	14.7	35.4	25.1	22.1	24.8
Fluoranthene	31.2	24.1	25.8	39.5	50.9	38.4	35.6	48.2	35.4	28.5	43.5	30.8	21.3	16.7	19.6	25.8	21.8	11.9	11.1	10.8	23.8
Pyrene	51.1	57.8	54.1	66.4	75.1	83.2	59.1	66.0	73.2	48.5	57.8	62.4	31.2	37.5	40.7	23.2	25.5	29.1	16.6	26.3	26.6
Benzo (a) fluorene	37.9	36.5	23.8	51.9	46.8	30.6	49.3	62.3	27.8	38.9	53.6	22.9	24.9	25.3	14.4	27.6	26.3	11.0	14.0	12.2	19.3
1-methylpyrene	42.6	32.9	33.0	56.7	47.7	49.2	51.1	43.4	45.3	41.4	35.3	34.5	31.2	24.8	26.1	21.6	17.2	19.7	17.6	15.8	15.8
Benzo (a) anthracene	59.7	62.3	81.2	81.8	86.6	107	74.4	78.8	99.4	63.8	67.5	80.2	40.9	35.3	54.5	31.1	29.4	40.6	25.4	26.0	27.8
Chrysene	45.2	71.1	51.3	68.5	103	73.3	63.7	96.9	68.2	51.4	81.4	58.6	32.9	49.5	40.3	26.7	30.2	22.7	24.0	26.8	24.9
5-methylchrysene	56.2	41.2	36.5	78.1	74.9	53.7	68.7	49.4	48.8	58.5	40.6	41.3	39.8	28.6	24.7	26.5	22.0	20.4	25.0	18.7	27.8
Benzo (b) fluoranthene	24.5	16.8	22.7	35.5	25.5	28.8	33.7	44.9	26.5	25.2	28.7	23.0	17.8	13.5	13.8	22.4	18.2	8.63	10.7	8.91	17.5
Benzo (k) fluoranthene	56.6	47.3	42.9	79.8	70.6	55.0	74.2	64.2	51.1	58.2	50.8	42.3	43.1	26.1	25.8	26.3	21.2	17.0	26.3	17.7	15.9
Benzo (e) pyrene	24.0	27.4	18.5	31.1	34.7	28.4	28.0	31.3	25.0	24.6	35.4	21.9	15.6	18.8	13.6	12.1	18.6	9.38	7.79	9.73	19.5
Benzo (a) Pyrene	26.9	27.9	38.0	39.5	38.8	47.5	37.2	34.9	42.3	31.2	30.2	34.2	20.2	17.4	21.9	15.4	12.0	19.0	10.7	12.4	14.3
Perylene	59.1	57.2	31.2	75.8	78.4	44.6	69.7	71.3	41.9	55.3	59.6	33.5	37.1	32.7	20.1	25.0	15.8	16.1	24.2	23.5	11.6
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	1414	1374	1372	1927	2040	1901	1625	1733	1601	1310	1463	1299	903	790	854	694	621	625	540	531	641

Table A.8. Summary of the PAH (µg/Kg, dry weight) content in triploid oysters during summer exposure study.

Name	Water Control Treatment																							
	Week 0			Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Naphthalene	2.09	1.78	1.76	1.91	1.67	1.65	1.80	1.52	1.51	1.69	1.42	1.41	1.48	1.15	1.17	0.99	0.94	0.95	0.63	0.56	0.45	0.79	0.50	0.61
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	2.63	2.41	2.41	2.50	2.25	2.25	2.25	2.07	2.12	2.03	1.95	1.89	1.74	1.58	1.76	1.28	1.24	1.38	0.81	0.73	0.80	0.99	0.77	0.91
Biphenyl	0.62	0.58	0.56	0.59	0.53	0.51	0.54	0.49	0.48	0.50	0.46	0.43	0.43	0.40	0.38	0.34	0.29	0.27	0.18	0.17	0.14	0.21	0.21	0.18
2-ethylnaphthalene	1.73	1.49	1.42	1.58	1.40	1.36	1.45	1.28	1.25	1.38	1.20	1.14	1.07	1.02	0.97	0.91	0.83	0.81	0.52	0.51	0.45	0.59	0.57	0.47
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	1.48	1.27	1.30	1.36	1.17	1.18	1.25	1.11	1.09	1.15	1.03	1.03	1.01	0.90	0.83	0.81	0.67	0.60	0.39	0.41	0.37	0.53	0.36	0.41
Dibenzofuran	1.43	1.27	1.29	1.31	1.17	1.18	1.23	1.11	1.11	1.15	1.05	1.00	1.00	0.88	0.92	0.72	0.70	0.62	0.37	0.39	0.33	0.37	0.49	0.49
Fluorene	1.51	1.29	1.30	1.43	1.21	1.24	1.34	1.13	1.13	1.28	0.99	0.99	1.01	0.90	0.90	0.86	0.71	0.70	0.40	0.45	0.41	0.58	0.35	0.45
Dibenzothiophene	1.86	1.59	1.64	1.70	1.50	1.51	1.57	1.36	1.38	1.38	1.23	1.31	1.27	1.13	1.13	0.97	0.89	0.88	0.60	0.42	0.44	0.67	0.57	0.51
Phenanthrene	2.26	1.96	1.89	2.07	1.87	1.80	1.89	1.68	1.64	1.74	1.53	1.44	1.51	1.33	1.36	1.06	0.92	1.03	0.58	0.65	0.62	0.64	0.74	0.57
Anthracene	3.15	2.75	2.89	2.95	2.59	2.62	2.71	2.36	2.49	2.55	2.12	2.29	2.20	1.96	1.84	1.65	1.35	1.62	0.81	0.73	0.95	0.87	0.85	0.82
Carbozole	1.92	1.73	1.60	1.74	1.57	1.50	1.59	1.49	1.39	1.49	1.31	1.23	1.30	1.15	1.03	1.03	0.88	0.78	0.54	0.52	0.54	0.67	0.66	0.50
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	1.96	1.68	1.76	1.80	1.60	1.60	1.68	1.49	1.48	1.58	1.34	1.33	1.31	1.24	1.21	0.96	0.97	0.89	0.64	0.49	0.49	0.74	0.61	0.60
2-methylanthracene	0.77	0.65	0.66	0.70	0.62	0.60	0.63	0.58	0.56	0.60	0.53	0.51	0.49	0.48	0.43	0.37	0.37	0.34	0.23	0.19	0.21	0.25	0.24	0.23
1-methylphenanthrene	1.08	0.97	1.00	1.02	0.89	0.92	0.97	0.83	0.88	0.87	0.78	0.81	0.74	0.63	0.69	0.61	0.47	0.52	0.30	0.31	0.28	0.35	0.32	0.39
3,6-dimethylphenanthrene	1.44	1.26	1.34	1.36	1.18	1.22	1.26	1.09	1.16	1.15	0.97	1.02	0.97	0.84	0.96	0.78	0.66	0.73	0.44	0.42	0.44	0.48	0.41	0.46
Fluoranthene	0.77	0.69	0.67	0.72	0.63	0.61	0.67	0.57	0.57	0.60	0.53	0.50	0.53	0.47	0.42	0.38	0.35	0.34	0.23	0.19	0.20	0.29	0.17	0.20
Pyrene	2.02	1.75	1.82	1.87	1.62	1.68	1.77	1.49	1.55	1.63	1.33	1.42	1.37	1.21	1.28	0.99	0.87	0.90	0.59	0.48	0.53	0.53	0.48	0.49
Benzo (a) fluorene	0.91	0.80	0.80	0.86	0.74	0.75	0.80	0.70	0.68	0.75	0.63	0.62	0.66	0.53	0.54	0.49	0.41	0.43	0.29	0.22	0.21	0.25	0.27	0.24
1-methylpyrene	2.15	1.87	1.90	2.05	1.78	1.74	1.91	1.68	1.64	1.74	1.51	1.46	1.49	1.37	1.34	1.16	1.09	1.06	0.67	0.67	0.56	0.80	0.55	0.51
Benzo (a) anthracene	3.00	2.51	2.56	2.73	2.32	2.35	2.51	2.09	2.11	2.21	1.84	1.90	2.04	1.71	1.75	1.46	1.36	1.27	0.75	0.84	0.74	1.11	0.88	0.89
Chrysene	2.90	2.61	2.50	2.63	2.37	2.29	2.40	2.23	2.09	2.23	2.03	1.88	1.89	1.85	1.54	1.51	1.45	1.29	0.84	0.76	0.79	0.79	0.96	0.94
5-methylchrysene	2.20	1.88	1.91	2.00	1.76	1.76	1.84	1.65	1.63	1.71	1.49	1.45	1.51	1.24	1.23	1.16	1.04	0.93	0.61	0.51	0.54	0.66	0.63	0.64
Benzo (b) fluoranthene	0.86	0.77	0.73	0.81	0.71	0.69	0.75	0.66	0.65	0.68	0.60	0.62	0.60	0.49	0.52	0.47	0.38	0.37	0.23	0.20	0.20	0.34	0.20	0.21
Benzo (k) fluoranthene	1.92	1.73	1.67	1.80	1.60	1.56	1.62	1.49	1.45	1.44	1.38	1.35	1.21	1.14	1.18	0.89	0.97	0.89	0.53	0.52	0.52	0.60	0.55	0.52
Benzo (e) pyrene	0.61	0.55	0.55	0.57	0.50	0.50	0.52	0.47	0.47	0.49	0.41	0.43	0.41	0.35	0.39	0.33	0.28	0.27	0.21	0.18	0.17	0.18	0.16	0.15
Benzo (a) Pyrene	1.00	0.87	0.89	0.91	0.79	0.81	0.86	0.75	0.76	0.80	0.68	0.72	0.68	0.61	0.60	0.56	0.48	0.50	0.33	0.28	0.28	0.32	0.30	0.28
Perylene	1.53	1.31	1.30	1.39	1.21	1.20	1.29	1.14	1.08	1.18	1.07	1.01	0.97	0.89	0.84	0.76	0.73	0.68	0.43	0.36	0.41	0.49	0.43	0.44
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	45.8	40.0	40.1	42.4	37.3	37.1	39.1	34.5	34.3	36.0	31.4	31.2	30.9	27.4	27.2	23.5	21.3	21.1	13.2	12.2	12.1	15.1	13.2	13.1

Table A.8. Summary of the PAH (µg/Kg, dry weight) content in triploid oysters during summer exposure study (continued).

	Sediemnt Control Treatment																				
	Week			Week			Week			Week			Week			Week			Week		
Name	1			2			3			4			5			6			7		
Naphthalene	2.29	2.05	1.97	1.97	1.72	1.67	1.87	1.66	1.63	1.51	1.19	1.22	1.44	1.21	1.20	1.37	1.15	1.14	0.88	0.76	0.59
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	2.91	2.80	2.80	2.50	2.38	2.43	2.38	2.29	2.26	2.15	1.71	1.90	1.80	1.76	1.68	1.60	1.46	1.57	1.12	0.95	1.02
Biphenyl	0.72	0.67	0.62	0.61	0.59	0.53	0.59	0.54	0.50	0.49	0.41	0.40	0.45	0.41	0.34	0.36	0.38	0.33	0.25	0.23	0.21
2-ethylnaphthalene	1.84	1.65	1.67	1.57	1.43	1.42	1.57	1.40	1.34	1.11	1.15	1.09	1.12	0.97	1.02	1.05	0.84	0.92	0.69	0.60	0.53
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	1.59	1.42	1.44	1.33	1.19	1.26	1.30	1.25	1.25	0.95	1.05	0.95	1.00	0.78	0.92	0.83	0.80	0.85	0.48	0.47	0.53
Dibenzofuran	1.59	1.43	1.44	1.34	1.22	1.23	1.40	1.19	1.17	1.11	1.02	0.90	0.97	0.93	0.92	0.92	0.83	0.72	0.48	0.45	0.55
Fluorene	1.77	1.52	1.44	1.51	1.31	1.25	1.42	1.34	1.16	1.31	0.90	0.93	1.15	0.93	0.79	0.92	0.78	0.72	0.60	0.52	0.52
Dibenzothiophene	2.08	1.79	1.82	1.77	1.55	1.58	1.71	1.45	1.47	1.25	1.16	1.27	1.27	1.07	1.06	1.15	0.93	1.00	0.80	0.59	0.68
Phenanthrene	2.41	2.15	2.13	2.13	1.89	1.84	2.05	1.74	1.86	1.76	1.44	1.45	1.52	1.27	1.28	1.35	1.14	1.15	0.74	0.72	0.72
Anthracene	3.63	3.14	3.24	3.13	2.76	2.82	2.94	2.83	2.66	2.73	2.10	2.24	2.07	1.85	2.01	1.82	1.60	1.68	1.19	0.99	1.13
Carbozole	2.11	2.01	1.81	1.84	1.73	1.52	1.81	1.63	1.50	1.52	1.47	1.18	1.31	1.17	1.02	1.16	1.19	0.98	0.66	0.69	0.58
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	2.23	1.89	1.92	1.89	1.61	1.69	1.92	1.70	1.73	1.47	1.42	1.19	1.27	1.23	1.21	1.34	0.98	1.11	0.68	0.63	0.66
2-methylanthracene	0.81	0.74	0.72	0.69	0.63	0.63	0.65	0.65	0.58	0.47	0.51	0.45	0.47	0.45	0.43	0.47	0.38	0.42	0.25	0.25	0.25
1-methylphenanthrene	1.24	1.09	1.16	1.04	0.92	0.99	1.10	0.93	0.95	0.93	0.67	0.79	0.79	0.67	0.74	0.65	0.57	0.59	0.47	0.39	0.41
3,6-dimethylphenanthrene	1.60	1.38	1.50	1.35	1.20	1.26	1.44	1.10	1.32	1.09	1.02	1.08	1.01	0.85	0.82	0.88	0.76	0.75	0.48	0.47	0.52
Fluoranthene	0.89	0.73	0.74	0.78	0.62	0.63	0.74	0.64	0.61	0.60	0.46	0.48	0.55	0.45	0.44	0.51	0.40	0.43	0.32	0.25	0.25
Pyrene	2.36	1.96	1.96	2.05	1.65	1.69	1.94	1.63	1.67	1.53	1.33	1.30	1.32	1.14	1.14	1.32	1.12	1.14	0.86	0.72	0.74
Benzo (a) fluorene	1.03	0.94	0.91	0.86	0.82	0.80	0.87	0.83	0.80	0.66	0.59	0.64	0.56	0.59	0.53	0.53	0.54	0.54	0.39	0.30	0.32
1-methylpyrene	2.48	2.20	2.11	2.16	1.89	1.78	2.13	1.93	1.73	1.44	1.38	1.52	1.41	1.21	1.31	1.24	1.23	1.16	0.78	0.85	0.75
Benzo (a) anthracene	3.37	2.76	2.83	2.96	2.34	2.46	2.90	2.45	2.32	2.12	1.99	1.90	2.16	1.74	1.64	1.85	1.52	1.47	1.21	0.84	0.96
Chrysene	3.04	2.96	2.77	2.56	2.55	2.36	2.74	2.67	2.33	1.77	1.96	1.89	1.95	1.90	1.80	1.83	1.60	1.64	1.10	0.97	0.97
5-methylchrysene	2.33	2.23	2.19	1.96	1.92	1.86	2.03	1.78	1.93	1.54	1.40	1.51	1.42	1.27	1.23	1.17	1.23	1.31	0.71	0.73	0.65
Benzo (b) fluoranthene	0.98	0.87	0.83	0.85	0.74	0.72	0.88	0.75	0.68	0.73	0.61	0.50	0.61	0.49	0.52	0.58	0.46	0.44	0.37	0.29	0.32
Benzo (k) fluoranthene	2.10	1.95	1.87	1.77	1.67	1.65	1.83	1.69	1.67	1.53	1.25	1.22	1.22	1.17	1.22	1.24	1.13	1.01	0.64	0.69	0.63
Benzo (e) pyrene	0.69	0.62	0.62	0.58	0.53	0.54	0.59	0.50	0.52	0.49	0.40	0.39	0.45	0.34	0.39	0.35	0.35	0.34	0.22	0.21	0.22
Benzo (a) Pyrene	1.14	0.97	1.00	0.99	0.85	0.88	0.92	0.81	0.85	0.81	0.73	0.72	0.65	0.54	0.56	0.63	0.55	0.59	0.38	0.30	0.39
Perylene	1.70	1.50	1.45	1.42	1.26	1.27	1.36	1.25	1.29	1.17	1.13	1.05	0.97	0.98	0.92	0.90	0.81	0.77	0.61	0.52	0.57
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	50.9	45.4	45.0	43.6	39.0	38.8	43.1	38.6	37.8	34.2	30.4	30.1	30.9	27.3	27.1	28.0	24.7	24.8	17.4	15.4	15.6

Table A.8. Summary of the PAH (µg/Kg, dry weight) content in triploid oysters during summer exposure study (continued).

	500 ppm Treatment																				
	Week			Week			Week			Week			Week			Week			Week		
Name	1			2			3			4			5			6			7		
Naphthalene	17.6	14.3	15.4	29.9	24.4	23.0	18.5	15.3	14.7	9.87	7.31	8.29	10.5	8.52	8.06	9.87	7.31	8.29	7.21	6.35	5.98
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	22.7	20.7	20.7	31.7	29.0	31.0	19.0	19.1	20.8	11.7	11.6	9.31	9.52	10.1	9.93	8.14	7.62	6.98	4.57	3.87	5.74
Biphenyl	5.46	4.93	4.83	9.83	6.90	8.21	9.04	6.14	7.55	7.86	5.17	6.07	6.29	4.14	5.01	3.05	2.14	2.95	2.46	1.93	2.05
2-ethylnaphthalene	13.4	12.5	12.0	24.2	22.5	19.3	22.3	20.5	17.9	17.9	18.3	15.8	15.0	14.6	13.1	9.68	8.56	6.36	7.75	7.66	5.20
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	12.7	11.1	10.5	19.1	17.7	16.8	17.5	16.5	14.8	14.5	13.1	13.1	12.6	11.9	11.6	5.91	6.74	5.37	5.15	6.21	4.19
Dibenzofuran	11.3	11.5	11.4	17.0	20.6	18.3	15.9	18.8	16.8	13.4	15.7	13.5	10.3	12.8	11.1	5.09	7.43	6.94	5.09	6.60	6.02
Fluorene	13.6	11.7	11.2	19.1	18.8	19.0	18.1	17.3	17.3	14.9	13.7	15.4	12.4	13.1	12.8	7.26	6.57	7.23	5.73	6.01	5.14
Dibenzothiophene	15.4	14.1	12.7	21.6	24.0	20.4	19.4	22.5	18.5	16.8	19.2	16.5	13.2	16.3	13.9	8.20	8.63	6.11	5.83	6.23	5.71
Phenanthrene	17.9	15.3	15.8	32.2	25.9	26.8	28.3	23.4	25.5	26.1	21.3	20.7	22.2	17.9	18.8	10.0	8.30	8.86	10.9	6.49	7.52
Anthracene	28.3	22.9	24.3	39.7	34.4	43.7	36.1	30.6	40.7	29.8	25.8	34.1	27.8	22.3	28.9	12.3	11.7	16.2	10.3	8.94	12.2
Carbozole	15.8	14.1	14.5	22.2	19.7	21.8	20.8	17.7	20.0	16.8	15.4	16.7	15.1	12.2	14.8	8.86	6.90	6.53	7.75	6.11	7.61
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	15.6	14.0	13.4	28.1	19.6	18.8	25.6	17.7	17.5	20.8	15.5	15.2	17.4	12.4	12.2	9.83	7.26	6.20	8.42	5.30	5.64
2-methylanthracene	5.75	5.83	5.47	10.3	10.5	9.8	9.62	9.24	8.76	8.17	8.40	7.38	6.73	7.24	6.59	3.73	3.78	3.64	3.52	3.04	2.95
1-methylphenanthrene	9.14	7.77	8.21	13.7	12.4	14.8	12.3	11.2	13.4	11.1	9.32	11.2	8.37	7.95	8.86	4.25	4.35	4.73	3.43	3.23	5.17
3,6-dimethylphenanthrene	12.8	9.65	11.2	21.8	13.5	16.8	19.2	11.9	14.8	15.9	11.1	13.6	15.0	8.92	10.8	6.97	4.86	5.05	5.66	4.46	4.21
Fluoranthene	6.98	5.79	5.22	12.6	8.11	8.4	11.9	7.13	7.60	10.2	5.92	6.76	8.79	5.67	5.85	3.89	2.43	2.67	4.27	2.59	2.76
Pyrene	18.4	14.3	15.7	27.6	20.0	25.1	26.0	18.4	22.4	20.2	15.8	20.6	16.8	12.0	15.3	10.5	7.41	9.05	8.56	6.60	6.29
Benzo (a) fluorene	7.70	6.99	6.81	11.5	11.2	11.6	10.9	10.3	10.8	8.43	8.50	8.80	6.93	6.93	7.87	3.81	4.02	4.28	3.81	3.13	3.36
1-methylpyrene	19.6	16.0	15.6	35.2	25.7	23.5	31.7	23.9	21.8	28.9	19.8	17.4	22.9	17.7	16.2	13.0	8.21	7.74	12.0	6.41	8.2
Benzo (a) anthracene	25.3	21.2	22.4	40.4	38.2	38.0	37.2	33.6	35.0	29.5	30.6	27.8	27.9	24.5	23.2	13.3	14.9	14.8	12.9	12.6	9.9
Chrysene	22.2	21.9	21.1	37.8	32.9	31.6	34.4	30.6	29.1	29.8	26.3	25.6	26.1	22.0	19.9	11.3	12.5	9.80	13.2	8.55	10.7
5-methylchrysene	18.4	17.2	16.4	25.8	29.2	27.9	23.7	26.3	26.2	20.4	23.6	20.9	15.5	20.1	18.7	9.54	9.63	9.49	8.00	9.92	8.09
Benzo (b) fluoranthene	7.27	6.62	6.62	12.4	11.9	11.9	11.7	11.1	10.5	9.76	9.53	9.77	8.52	7.98	7.39	4.08	4.76	4.65	4.20	3.33	4.05
Benzo (k) fluoranthene	15.1	14.2	14.4	25.7	19.9	23.1	24.4	18.3	21.0	20.1	15.9	17.8	16.2	13.5	14.8	9.77	7.76	8.08	7.72	6.77	7.16
Benzo (e) pyrene	5.02	4.57	4.59	8.03	7.77	6.88	7.30	7.38	6.12	6.50	6.06	5.23	5.06	4.98	4.54	2.65	2.57	2.20	2.17	2.02	1.93
Benzo (a) Pyrene	9.02	7.60	7.01	15.3	13.7	11.2	14.6	12.7	10.5	11.3	11.2	8.9	9.66	9.57	6.73	4.75	4.10	3.36	4.91	4.65	3.03
Perylene	12.0	11.1	10.2	16.9	20.0	17.3	15.8	18.2	15.7	12.3	14.8	13.8	10.4	13.2	11.8	5.90	6.80	5.88	4.55	6.20	5.71
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	384.6	338	337.7	610	539	545	542	476	486	443	399	400	377	339	339	206	187	183	180	155	157

Table A.8. Summary of the PAH (µg/Kg, dry weight) content in triploid oysters during summer exposure study (continued).

	5000 ppm Treatment																				
	Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Name																					
Naphthalene	78.6	58.7	61.1	111	87.7	78.3	65.3	46.5	47.0	50.9	45.6	42.3	42.1	31.6	24.3	31.4	26.8	22.4	12.1	15.4	14.1
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	85.7	75.9	86.9	117.4	98.6	108.6	66.9	55.2	65.2	64.6	45.3	53.2	48.2	35.5	42.4	35.1	25.4	23.8	18.9	15.4	12.7
Biphenyl	23.7	16.4	21.6	33.4	23.4	30.4	30.4	22.0	29.2	23.4	16.2	21.0	16.7	13.4	16.4	17.4	10.5	14.9	12.7	9.61	10.3
2-ethylnaphthalene	55.1	52.1	47.0	79.9	76.6	63.6	74.3	71.3	59.1	59.9	52.9	48.3	41.5	41.4	36.9	38.3	39.1	35.0	32.8	29.1	26.7
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	45.9	45.7	49.7	62.9	58.6	63.8	57.2	55.0	61.2	43.4	41.6	43.4	31.5	34.0	37.6	32.7	28.7	35.1	21.4	19.9	22.3
Dibenzofuran	40.8	57.2	45.8	62.7	78.4	60.2	59.6	74.5	57.8	44.6	58.0	45.2	31.4	43.9	33.1	31.4	36.1	27.1	20.7	32.9	21.1
Fluorene	55.8	42.8	48.6	70.7	63.8	70.4	67.8	60.0	66.9	49.5	47.9	52.1	42.4	37.7	40.2	38.9	31.3	33.1	29.7	21.7	25.4
Dibenzothiophene	49.1	66.5	51.4	71.2	88.7	71.3	65.5	85.2	67.0	54.1	62.1	54.2	39.9	49.7	42.8	33.5	40.8	32.8	24.9	29.3	28.5
Phenanthrene	72.2	64.1	63.9	106	98.6	91.3	97.7	93.7	83.1	79.6	72.0	66.6	55.2	50.3	48.4	48.8	53.2	42.9	39.3	35.5	32.9
Anthracene	104	90.1	112	139	131	153	129	120	147	103	96.7	110	76.4	74.5	88.8	65.3	71.9	73.5	45.8	48.3	59.7
Carbozole	51.2	53.3	66.1	75.3	73.0	82.7	70.8	68.6	76.9	56.5	52.5	59.5	39.9	43.8	41.3	38.4	36.5	41.3	30.1	24.1	27.3
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	85.4	56.7	54.3	107	74.6	71.4	98.2	70.8	68.6	73.6	50.7	52.1	60.8	41.8	40.7	51.2	33.6	37.9	36.3	25.4	25.0
2-methylanthracene	30.3	26.5	29.9	39.3	37.8	37.4	37.7	34.4	35.2	26.7	27.2	25.4	20.8	22.7	22.4	20.1	17.8	18.7	15.3	13.2	15.3
1-methylphenanthrene	35.8	29.1	43.2	45.3	44.7	56.1	43.0	41.2	52.2	33.9	30.9	41.0	23.5	24.2	32.6	24.9	22.8	27.5	17.2	17.0	19.1
3,6-dimethylphenanthrene	53.4	34.4	47.2	76.2	51.3	60.6	72.4	47.7	56.9	52.6	37.0	43.0	38.9	30.8	32.7	38.9	26.2	31.5	29.0	18.0	21.8
Fluoranthene	32.5	22.2	19.3	44.0	30.8	29.2	40.0	29.0	26.9	32.1	21.6	20.5	22.9	17.2	15.8	20.2	16.0	13.2	14.9	10.2	12.0
Pyrene	68.5	57.6	63.3	93.9	72.1	85.5	87.3	68.5	79.5	63.8	51.2	65.0	51.6	36.0	49.6	51.6	33.1	47.0	31.0	24.5	29.1
Benzo (a) fluorene	28.6	29.8	29.5	42.7	40.2	42.8	39.3	37.8	41.1	32.0	28.6	31.3	23.5	20.1	21.4	19.6	22.1	19.7	16.2	16.9	17.6
1-methylpyrene	99.1	74.1	58.3	134	97.5	84.4	129	92.6	79.4	96.4	73.1	59.1	77.7	49.7	46.4	60.3	50.7	38.0	44.2	40.9	32.1
Benzo (a) anthracene	114	96.3	85.4	154	134	126	147	128	121	111	97.7	92.9	92.1	78.9	66.5	84.5	64.2	65.3	59.9	53.5	41.4
Chrysene	93.5	91.0	80.7	125	115	117	115	105	112	86.0	85.2	80.7	73.5	63.3	65.5	62.3	57.6	55.0	48.6	39.1	49.1
5-methylchrysene	63.9	77.7	64.5	95.4	108	92.1	89.7	101	88.4	65.8	82.0	68.1	47.7	64.8	54.3	52.5	56.1	42.4	34.4	39.9	33.2
Benzo (b) fluoranthene	33.7	31.2	27.9	43.2	45.3	41.7	40.6	43.0	39.6	32.9	34.8	30.4	24.2	23.5	21.3	22.5	20.4	20.8	17.3	18.6	16.3
Benzo (k) fluoranthene	67.3	51.2	55.8	87.4	65.7	80.8	82.2	60.4	75.2	59.5	48.6	59.0	49.0	33.5	46.1	39.4	31.5	42.8	32.4	26.3	31.5
Benzo (e) pyrene	20.5	17.2	17.1	28.9	25.7	23.4	26.3	23.9	21.8	19.6	18.0	16.4	16.8	13.9	12.4	15.9	12.3	12.9	10.7	9.23	9.36
Benzo (a) Pyrene	37.4	34.9	26.3	56.7	46.5	37.0	52.2	44.6	35.5	41.4	33.0	26.3	29.5	27.0	20.7	28.9	24.6	17.0	18.7	15.8	15.5
Perylene	43.4	53.2	43.4	55.6	76.0	57.1	53.4	71.5	52.5	41.7	56.3	38.8	27.8	44.1	29.7	28.4	41.1	31.4	19.5	31.9	24.0
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	1569	1406	1400	2157	1943	1916	1938	1752	1746	1498	1366	1346	1145	1047	1030	1032	930	903	734	682	673

Table A.8. Summary of the PAH (µg/Kg, dry weight) content in triploid oysters during summer exposure study (continued).

	25000 ppm Treatment																				
	Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Name																					
Naphthalene	133	103	73.3	166	131	94.0	91.3	81.5	56.4	76.4	73.6	43.2	56.5	46.0	37.0	36.0	24.0	33.0	26.0	36.0	27.0
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	117	115	132	141	148	163	81.7	90.2	89.6	74.7	81.3	78.2	35.2	35.5	50.5	25.8	21.4	18.3	15.6	25.4	11.7
Biphenyl	37.4	24.6	36.9	46.8	35.2	48.6	44.0	32.4	46.6	33.2	25.7	34.5	29.0	21.8	30.1	28.1	16.5	22.8	31.0	30.0	37.0
2-ethylnaphthalene	81.0	94.3	88.6	104	115	108	95.5	109	104	81.0	87.4	76.7	62.3	66.7	65.9	53.0	64.4	60.5	26.0	37.9	34.6
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	59.7	61.5	59.7	81.8	87.8	76.5	74.4	79.0	68.9	58.1	67.6	55.8	46.6	50.1	46.7	39.3	45.7	41.3	32.0	29.0	26.0
Dibenzofuran	61.2	92.8	62.4	81.6	125	84.3	79.1	120	81.0	66.9	89.0	61.6	48.1	76.5	50.6	40.8	72.7	43.9	29.0	40.0	34.0
Fluorene	65.3	81.4	74.2	84.8	109	91.6	76.3	105	87.9	68.7	89.0	70.5	52.6	59.7	53.1	44.1	48.8	52.2	40.0	25.0	22.0
Dibenzothiophene	64.8	122	67.7	92.6	151	92.7	87.0	139	87.2	68.5	122	67.7	50.9	83.0	55.6	50.9	78.4	47.3	33.0	52.8	32.0
Phenanthrene	136	137	102	170	168	128	153	161	115	138	122	101	98.5	93.9	79.2	95.1	77.1	74.1	44.2	53.6	35.8
Anthracene	148	143	169	208	196	214	188	186	193	160	147	152	119	118	135	117	114	109	54.2	54.9	51.4
Carbozole	72.3	98.0	102	90.4	124	124	85.9	114	117	65.1	91.8	89.3	50.6	68.2	68.2	42.5	67.0	55.8	43.0	47.0	50.0
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	126	68.0	82.3	160	89.5	114	154	82.3	103	120	72.5	88.0	89.6	52.8	68.6	96.0	44.7	65.1	56.0	31.0	40.0
2-methylanthracene	37.7	37.6	37.0	47.2	45.4	48.6	44.8	41.7	45.7	34.4	34.9	35.5	26.0	27.2	30.6	25.5	26.3	24.8	36.0	35.0	31.0
1-methylphenanthrene	39.1	59.3	69.9	54.3	76.0	84.2	52.1	70.7	78.3	42.9	57.0	62.3	34.2	47.9	53.0	32.6	41.1	48.8	37.0	37.0	20.2
3,6-dimethylphenanthrene	83.2	48.0	59.6	107	61.6	72.7	98.2	59.7	70.5	88.6	43.7	56.7	58.7	37.6	45.8	49.1	35.1	42.9	25.6	25.0	30.0
Fluoranthene	43.3	31.2	31.1	52.7	40.0	43.8	49.1	36.0	41.2	40.1	31.2	31.6	33.2	24.0	26.3	27.4	23.6	21.5	35.0	24.0	21.0
Pyrene	111	85.4	121	141	108	145	127	97.3	131	108	76.7	113	83.1	61.6	82.8	83.1	49.7	77.0	43.7	31.3	33.4
Benzo (a) fluorene	50.8	47.7	42.6	72.6	64.4	59.9	66.1	61.8	57.0	51.6	52.2	45.0	45.7	38.6	36.0	36.3	34.1	28.2	27.0	25.0	24.0
1-methylpyrene	132	108	86.3	174	136	118	157	128	111	129	96.9	91.0	110	77.8	74.5	99.2	69.6	69.7	64.0	42.3	41.0
Benzo (a) anthracene	187	163	143	230	214	201	210	197	185	189	169	159	145	118	119	108	128	102	69.1	64.2	68.3
Chrysene	156	117	101	199	150	140	193	138	129	166	117	104	126	88.3	87.0	102	71.8	78.6	67.8	49.4	49.1
5-methylchrysene	81.3	150	116	115	184	147	108	173	139	84.7	141	113	67.6	112	88.4	61.8	105	69.3	28.6	53.2	35.4
Benzo (b) fluoranthene	43.0	41.8	38.5	60.5	54.3	54.2	56.3	50.5	51.5	46.0	43.4	39.6	34.5	31.0	32.0	34.5	28.8	26.6	29.0	28.0	38.0
Benzo (k) fluoranthene	102	81.5	83.0	131	112	105	127	102	99.8	99.7	79.3	85.1	72.1	65.9	63.0	69.5	64.8	62.0	30.2	30.1	29.4
Benzo (e) pyrene	36.3	32.8	29.4	49.1	41.0	39.8	44.7	39.4	36.6	39.8	29.1	29.0	30.5	23.4	23.1	23.1	19.7	19.1	36.0	29.0	22.0
Benzo (a) Pyrene	76.2	54.4	40.4	96.5	69.7	51.8	88.7	66.2	49.7	80.1	51.6	38.3	54.0	43.9	30.6	45.3	36.3	31.1	30.9	20.9	18.1
Perylene	68.4	94.4	61.6	83.4	129	79.9	79.3	120	77.6	60.9	102	60.0	50.1	80.1	47.2	50.1	59.5	48.0	20.9	38.8	24.8
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	2349	2293	2110	3040	2964	2731	2710	2681	2451	2271	2195	1982	1709	1649	1579	1516	1468	1374	1011	996	887

Table A.9. Summary of the PAH (µg/Kg, dry weight) content in diploid oysters during winter exposure study.

Name	Water Control Treatment																							
	Week 0			Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Naphthalene	2.26	2.63	2.95	2.15	2.39	2.73	2.39	2.75	3.11	2.10	2.42	2.95	1.86	2.25	2.36	1.41	1.79	1.93	0.76	1.07	1.21	0.91	1.21	1.37
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	2.99	3.20	3.67	2.85	3.05	3.37	2.99	3.38	3.82	2.67	3.15	3.37	2.40	2.54	3.17	1.71	2.00	2.29	1.14	1.35	1.30	1.35	1.15	1.26
Biphenyl	0.72	0.74	0.87	0.68	0.68	0.79	0.71	0.79	0.88	0.66	0.72	0.78	0.55	0.62	0.69	0.41	0.47	0.51	0.29	0.27	0.32	0.26	0.31	0.35
2-ethylnaphthalene	1.94	2.05	2.37	1.83	1.95	2.22	1.93	2.22	2.46	1.83	2.00	2.19	1.60	1.82	1.95	1.16	1.35	1.38	0.60	0.71	0.81	0.68	1.00	0.84
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	1.72	1.85	2.02	1.58	1.73	1.87	1.74	1.96	2.18	1.65	1.85	2.00	1.32	1.63	1.76	1.09	1.26	1.24	0.61	0.67	0.78	0.71	0.77	0.87
Dibenzofuran	1.64	1.76	2.02	1.54	1.64	1.87	1.66	1.91	2.12	1.46	1.68	1.87	1.25	1.43	1.63	1.08	1.13	1.27	0.65	0.59	0.74	0.71	0.80	0.87
Fluorene	1.76	1.85	2.05	1.64	1.71	1.93	1.73	1.97	2.25	1.61	1.73	1.98	1.28	1.60	1.77	0.97	1.10	1.44	0.55	0.65	0.76	0.62	0.81	0.97
Dibenzothiophene	2.10	2.11	2.38	1.91	1.97	2.22	2.01	2.29	2.52	1.85	2.13	2.25	1.63	1.81	1.94	1.23	1.31	1.49	0.72	0.83	0.88	0.70	0.78	0.83
Phenanthrene	2.46	2.55	2.92	2.30	2.40	2.70	2.42	2.76	3.18	2.16	2.57	3.02	1.96	2.29	2.51	1.45	1.52	1.88	0.80	1.05	1.18	0.73	0.91	1.14
Anthracene	3.48	3.95	4.37	3.31	3.66	4.13	3.64	4.11	4.69	3.42	3.66	4.22	2.80	3.41	3.84	2.33	2.26	2.86	1.13	1.28	1.88	1.60	1.52	1.83
Carbozole	2.20	2.32	2.48	2.00	2.17	2.36	2.20	2.47	2.71	2.07	2.27	2.41	1.74	2.05	2.06	1.26	1.58	1.57	0.70	0.79	1.00	0.73	1.06	1.06
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	2.20	2.29	2.69	2.00	2.18	2.45	2.15	2.48	2.75	1.94	2.20	2.42	1.66	1.93	2.06	1.29	1.36	1.70	0.67	0.77	1.04	0.80	0.97	1.02
2-methylanthracene	0.89	0.95	1.08	0.82	0.87	0.98	0.88	1.01	1.14	0.82	0.94	1.00	0.69	0.80	0.91	0.55	0.59	0.73	0.30	0.30	0.45	0.28	0.39	0.48
1-methylphenanthrene	1.22	1.30	1.45	1.14	1.22	1.36	1.24	1.37	1.58	1.14	1.25	1.41	1.03	1.14	1.31	0.77	0.80	0.92	0.43	0.45	0.58	0.38	0.51	0.55
3,6-dimethylphenanthrene	1.63	1.77	2.05	1.54	1.69	1.92	1.69	1.90	2.18	1.49	1.76	2.07	1.30	1.52	1.77	1.07	1.21	1.35	0.64	0.63	0.68	0.56	0.76	0.81
Fluoranthene	0.92	0.99	1.10	0.85	0.92	1.05	0.93	1.07	1.20	0.87	1.01	1.14	0.73	0.79	1.00	0.58	0.62	0.77	0.30	0.41	0.45	0.37	0.44	0.45
Pyrene	2.20	2.29	2.69	2.08	2.12	2.47	2.18	2.49	2.74	1.99	2.19	2.52	1.77	1.89	2.08	1.42	1.39	1.78	0.79	0.80	1.10	0.76	1.10	0.85
Benzo (a) fluorene	1.09	1.20	1.27	1.01	1.09	1.21	1.09	1.26	1.41	1.03	1.17	1.24	0.89	0.97	1.14	0.67	0.70	0.86	0.44	0.47	0.52	0.34	0.53	0.55
1-methylpyrene	2.51	2.69	3.02	2.30	2.56	2.74	2.50	2.88	3.22	2.25	2.62	3.06	1.95	2.16	2.42	1.50	1.81	1.81	0.78	0.98	1.29	1.08	0.98	1.19
Benzo (a) anthracene	3.40	3.61	4.11	3.18	3.37	3.88	3.34	3.74	4.31	3.11	3.56	4.09	2.71	3.11	3.53	2.07	2.17	2.76	1.34	1.24	1.29	1.17	1.35	1.64
Chrysene	3.19	3.35	4.00	2.93	3.08	3.67	3.25	3.58	4.08	3.02	3.18	3.87	2.47	2.72	3.38	1.98	2.00	2.57	1.01	1.43	1.39	1.30	1.39	1.39
5-methylchrysene	2.38	2.49	2.74	2.24	2.30	2.58	2.46	2.71	3.04	2.34	2.41	2.70	2.00	2.06	2.46	1.48	1.68	1.97	0.79	1.03	0.91	1.08	1.19	1.21
Benzo (b) fluoranthene	1.00	0.99	1.15	0.95	0.93	1.05	1.00	1.10	1.24	0.92	1.03	1.13	0.79	0.87	0.99	0.58	0.64	0.71	0.40	0.33	0.37	0.38	0.36	0.37
Benzo (k) fluoranthene	2.12	2.18	2.57	2.02	2.08	2.34	2.19	2.41	2.65	2.02	2.15	2.36	1.62	1.98	2.04	1.27	1.54	1.70	0.77	0.75	1.04	0.79	1.09	0.98
Benzo (e) pyrene	0.71	0.78	0.89	0.67	0.74	0.85	0.75	0.84	0.97	0.71	0.79	0.87	0.58	0.69	0.79	0.47	0.46	0.59	0.22	0.29	0.38	0.28	0.36	0.43
Benzo (a) Pyrene	1.07	1.13	1.32	1.01	1.05	1.21	1.08	1.22	1.39	1.01	1.09	1.24	0.80	0.94	1.14	0.63	0.68	0.85	0.36	0.43	0.50	0.33	0.50	0.60
Perylene	1.74	1.81	2.14	1.64	1.64	1.95	1.74	1.93	2.17	1.62	1.82	2.01	1.34	1.57	1.65	0.99	1.22	1.26	0.57	0.77	0.84	0.59	0.66	0.69
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	51.5	54.8	62.4	48.2	51.2	57.9	51.9	58.6	66.0	47.8	53.4	60.2	40.7	46.6	52.4	31.4	34.7	40.2	17.8	20.3	23.7	19.5	22.9	24.6

Table A.9. Summary of the PAH (μg/Kg, dry weight) content in diploid oysters during winter exposure study (continued).

Name	Sediemnt Control Treatment																				
	Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Naphthalene	2.84	3.19	3.54	2.39	2.74	3.08	2.62	2.81	3.33	2.13	2.49	2.90	1.99	2.20	2.58	1.65	1.63	1.81	0.62	0.71	0.80
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	3.32	4.03	4.21	2.89	3.46	3.70	3.16	3.58	3.70	2.83	3.02	3.41	2.43	2.66	3.15	1.96	2.26	2.23	1.01	0.90	1.22
Biphenyl	0.86	0.93	0.98	0.73	0.78	0.83	0.75	0.85	0.87	0.67	0.74	0.74	0.63	0.62	0.68	0.50	0.52	0.53	0.23	0.23	0.23
2-ethylnaphthalene	2.32	2.62	2.73	2.04	2.30	2.41	2.13	2.36	2.57	1.97	2.20	2.08	1.55	1.75	1.78	1.20	1.34	1.64	0.61	0.60	0.82
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	2.02	2.32	2.53	1.71	1.97	2.17	1.81	2.20	2.27	1.57	1.83	1.95	1.41	1.51	1.74	1.19	1.32	1.39	0.53	0.55	0.61
Dibenzofuran	1.99	2.16	2.54	1.75	1.83	2.21	1.81	1.92	2.42	1.67	1.73	1.93	1.46	1.51	1.70	1.18	1.08	1.53	0.54	0.55	0.62
Fluorene	1.97	2.25	2.60	1.67	1.89	2.21	1.73	2.13	2.29	1.63	1.89	2.11	1.32	1.66	1.93	1.16	1.19	1.54	0.49	0.53	0.55
Dibenzothiophene	2.38	2.71	2.93	2.02	2.38	2.46	2.14	2.46	2.75	1.97	2.25	2.34	1.54	1.81	2.11	1.21	1.60	1.46	0.52	0.60	0.76
Phenanthrene	2.89	3.26	3.66	2.48	2.81	3.18	2.63	2.97	3.36	2.40	2.71	2.81	1.99	2.19	2.38	1.59	1.79	1.94	0.84	0.79	0.83
Anthracene	4.37	4.73	5.49	3.76	4.02	4.61	3.89	4.30	4.94	3.67	3.78	4.17	3.10	3.41	3.90	2.58	2.41	2.91	1.09	1.05	1.34
Carbozole	2.62	2.71	3.17	2.25	2.36	2.70	2.44	2.47	2.82	2.02	2.06	2.51	1.97	1.87	2.16	1.42	1.44	1.65	0.79	0.59	0.89
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	2.39	2.82	3.13	2.01	2.40	2.66	2.27	2.48	2.79	1.86	2.37	2.66	1.65	2.06	2.16	1.19	1.44	1.60	0.64	0.84	0.85
2-methylanthracene	0.98	1.12	1.27	0.85	0.98	1.08	0.90	1.07	1.12	0.79	0.93	0.96	0.65	0.77	0.85	0.58	0.63	0.68	0.25	0.28	0.30
1-methylphenanthrene	1.36	1.51	1.86	1.14	1.27	1.62	1.21	1.42	1.77	1.05	1.21	1.55	0.95	1.01	1.25	0.68	0.89	1.06	0.38	0.38	0.41
3,6-dimethylphenanthrene	2.00	2.18	2.51	1.70	1.83	2.18	1.82	1.94	2.28	1.54	1.64	2.11	1.32	1.59	1.78	1.00	1.24	1.30	0.58	0.46	0.65
Fluoranthene	1.12	1.25	1.34	0.94	1.07	1.15	1.00	1.13	1.26	0.91	0.94	1.10	0.82	0.94	0.99	0.59	0.64	0.74	0.30	0.27	0.40
Pyrene	2.56	2.79	3.12	2.25	2.34	2.69	2.33	2.62	2.87	2.02	2.23	2.53	1.74	1.90	2.31	1.43	1.48	1.62	0.70	0.70	0.78
Benzo (a) fluorene	1.29	1.48	1.56	1.12	1.28	1.34	1.21	1.32	1.44	1.08	1.17	1.24	0.96	1.08	1.05	0.74	0.74	0.83	0.33	0.37	0.47
1-methylpyrene	2.78	3.34	3.81	2.36	2.94	3.23	2.45	3.04	3.35	2.14	2.64	2.89	2.08	2.20	2.51	1.50	1.74	2.17	0.71	1.00	0.94
Benzo (a) anthracene	3.81	4.23	4.87	3.28	3.68	4.18	3.51	3.85	4.57	2.97	3.30	3.94	2.78	3.00	3.60	1.91	2.33	2.82	1.11	1.03	1.09
Chrysene	3.90	3.93	4.77	3.32	3.31	4.10	3.67	3.50	4.48	2.93	3.31	3.86	2.89	2.91	3.34	2.26	2.12	2.81	1.13	1.09	1.44
5-methylchrysene	2.93	2.98	3.43	2.52	2.53	2.95	2.70	2.83	3.26	2.40	2.36	2.71	2.11	1.94	2.54	1.70	1.58	1.92	0.68	0.63	0.94
Benzo (b) fluoranthene	1.11	1.27	1.39	0.97	1.10	1.17	1.00	1.18	1.24	0.89	0.98	1.07	0.78	0.85	0.93	0.56	0.70	0.83	0.31	0.37	0.39
Benzo (k) fluoranthene	2.57	2.80	3.03	2.18	2.44	2.57	2.39	2.63	2.81	1.92	2.10	2.42	1.92	2.10	2.06	1.44	1.51	1.54	0.72	0.80	0.67
Benzo (e) pyrene	0.84	1.01	1.11	0.72	0.84	0.95	0.74	0.94	1.00	0.69	0.77	0.89	0.58	0.66	0.73	0.47	0.51	0.65	0.23	0.23	0.31
Benzo (a) Pyrene	1.27	1.38	1.57	1.10	1.20	1.37	1.13	1.25	1.43	1.03	1.12	1.32	0.96	0.92	1.18	0.73	0.79	0.88	0.27	0.38	0.48
Perylene	2.09	2.24	2.38	1.82	1.97	2.10	1.96	2.09	2.10	1.67	1.82	1.79	1.42	1.53	1.74	1.21	1.32	1.36	0.58	0.55	0.67
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	60.6	67.2	75.5	52.0	57.7	64.9	55.4	61.4	69.1	48.4	53.6	60.0	43.0	46.7	53.1	33.6	36.2	41.5	16.2	16.5	19.5

Table A.9. Summary of the PAH (µg/Kg, dry weight) content in diploid oysters during winter exposure study (continued).

Name	500 ppm Treatment																				
	Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Naphthalene	16.8	17.5	20.5	21.8	26.3	26.7	12.7	14.7	15.5	8.51	10.3	9.08	7.42	8.42	8.01	5.50	6.80	4.10	4.50	3.50	6.10
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	18.9	20.5	21.9	30.3	30.8	28.4	19.1	17.3	17.1	12.1	12.3	8.53	7.88	10.5	9.10	7.12	6.54	8.53	6.21	4.35	5.87
Biphenyl	4.53	4.81	5.70	6.35	7.70	7.99	5.58	7.01	7.11	4.63	5.54	6.23	4.06	4.47	5.19	2.03	2.85	2.95	1.65	2.39	2.24
2-ethylnaphthalene	11.8	13.1	14.5	15.4	21.0	17.4	14.3	18.9	16.3	10.7	16.8	13.6	9.06	12.6	11.1	4.76	6.91	6.96	3.99	7.33	5.04
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	10.1	11.8	13.9	14.1	18.9	19.5	12.7	17.6	17.3	10.0	13.4	15.6	9.17	11.3	11.9	4.80	7.18	7.78	4.23	6.24	6.81
Dibenzofuran	10.8	10.8	14.5	15.1	14.0	17.4	13.3	13.3	16.5	10.5	9.96	12.7	8.59	8.42	10.6	4.52	4.63	6.96	3.92	3.93	4.53
Fluorene	10.6	11.7	14.3	16.0	18.7	17.2	15.0	17.2	16.2	12.8	14.6	12.4	9.73	11.2	10.8	5.90	6.91	6.70	5.27	5.04	6.02
Dibenzothiophene	13.8	16.0	14.6	20.7	22.4	22.0	19.4	21.0	20.2	14.7	17.4	17.6	11.6	13.4	12.3	6.82	8.05	7.91	6.41	6.93	6.59
Phenanthrene	17.3	17.0	20.1	24.2	20.4	34.2	22.3	18.7	30.1	18.2	15.3	26.3	14.5	12.0	21.5	8.73	7.33	12.3	8.24	5.50	9.57
Anthracene	21.8	23.7	28.5	30.6	33.1	42.8	28.7	30.1	37.7	22.6	26.2	32.9	19.9	18.5	25.7	11.0	11.6	15.4	7.64	10.3	13.7
Carbozole	15.2	16.0	17.8	24.3	22.4	26.7	22.6	19.9	23.7	17.3	16.6	20.3	13.6	12.8	14.9	7.54	7.84	10.4	7.54	6.95	6.93
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	12.4	15.0	16.0	14.9	20.9	19.2	13.4	19.9	17.8	10.7	16.5	14.4	9.10	13.0	10.9	5.07	6.28	7.29	5.22	5.86	5.18
2-methylanthracene	5.81	6.62	6.34	9.87	7.94	10.8	9.28	7.39	9.91	7.11	5.96	8.19	6.42	4.61	6.25	3.75	2.38	4.31	2.47	2.70	3.56
1-methylphenanthrene	7.62	8.15	11.2	12.2	10.6	13.4	11.5	9.86	12.7	9.39	7.42	10.6	7.68	6.89	8.32	4.88	3.29	4.02	3.41	3.39	3.76
3,6-dimethylphenanthrene	11.8	12.6	13.5	14.1	17.7	17.6	13.4	15.8	16.6	10.9	13.1	13.7	9.05	10.4	11.4	4.81	6.91	6.69	4.39	4.96	5.81
Fluoranthene	6.51	7.36	7.89	9.76	11.0	12.6	9.27	9.93	11.9	7.22	8.61	9.09	6.15	6.07	6.94	3.90	3.86	4.54	2.64	3.42	4.16
Pyrene	15.1	15.6	15.9	25.6	21.9	27.1	23.8	19.9	24.9	20.3	16.8	19.0	15.9	12.5	15.7	7.95	7.87	9.21	7.95	7.22	8.39
Benzo (a) fluorene	6.58	7.87	8.91	9.21	11.0	12.5	8.75	10.0	11.9	7.00	8.48	9.98	5.34	6.28	7.24	3.13	3.63	4.62	3.13	3.19	3.99
1-methylpyrene	14.2	19.0	19.4	22.7	30.5	25.2	20.4	28.6	24.0	15.9	23.2	19.9	14.1	19.2	14.9	7.48	10.4	7.57	7.03	10.7	6.81
Benzo (a) anthracene	20.2	22.8	27.7	26.3	34.3	47.2	24.9	31.5	44.8	18.9	24.0	36.8	15.5	20.9	30.6	10.5	13.7	17.4	6.83	10.3	12.7
Chrysene	20.3	22.4	25.3	24.3	35.9	35.4	21.9	33.0	31.5	17.0	26.2	26.5	14.6	21.5	22.7	7.79	13.3	14.2	7.30	10.0	11.7
5-methylchrysene	16.1	16.4	20.6	19.4	21.3	24.7	18.4	18.8	23.0	15.1	14.9	18.8	11.4	13.0	15.1	5.81	8.10	7.90	6.39	6.61	6.67
Benzo (b) fluoranthene	5.98	6.37	7.92	7.18	9.55	13.5	6.68	8.88	11.8	5.46	6.88	10.1	4.59	5.25	8.62	2.73	3.53	4.71	2.37	2.77	3.50
Benzo (k) fluoranthene	14.9	16.0	17.9	23.8	27.1	25.0	21.4	25.0	22.5	17.1	21.4	19.5	14.5	16.8	16.2	8.34	10.6	8.00	7.86	7.59	7.00
Benzo (e) pyrene	4.19	5.03	6.42	7.12	7.54	9.64	6.55	6.71	8.58	5.69	5.81	7.71	4.13	4.15	5.78	2.35	2.94	2.99	1.85	2.04	3.28
Benzo (a) Pyrene	7.26	7.17	8.02	11.6	8.60	13.6	10.2	7.66	12.4	8.48	6.28	10.4	6.51	5.33	8.86	4.30	2.84	5.04	3.25	2.32	4.50
Perylene	11.7	11.4	14.1	18.7	18.3	19.7	17.0	17.0	18.5	14.6	13.2	15.7	12.0	11.7	12.6	6.37	7.14	5.90	5.99	5.86	5.31
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	332	363	413	476	530	587	423	466	520	333	377	426	272	301	343	158	183	204	138	151	170

Table A.9. Summary of the PAH (µg/Kg, dry weight) content in diploid oysters during winter exposure study (continued).

Name	5000 ppm Treatment																				
	Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Naphthalene	55.0	71.8	55.5	78.5	92.1	85.4	44.0	48.8	44.4	33.0	46.0	37.6	30.6	30.4	35.0	23.0	26.0	17.6	20.3	10.4	15.2
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	72.2	86.3	65.7	106	108	93.8	62.6	48.5	48.8	45.6	46.4	46.9	38.2	45.3	31.0	25.6	26.4	16.9	18.2	15.3	11.0
Biphenyl	15.3	20.5	22.1	22.8	27.7	28.7	21.7	26.1	27.3	17.1	19.7	22.1	14.2	15.0	13.5	10.5	11.1	14.1	9.4	10.8	11.2
2-ethylnaphthalene	37.0	53.9	42.0	50.7	69.1	59.1	46.1	65.0	56.2	35.0	51.9	44.4	28.4	35.3	27.2	23.8	31.8	26.0	18.2	25.6	21.3
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	32.6	51.0	51.0	49.4	68.0	66.2	45.4	65.3	60.2	37.5	50.4	48.3	30.1	33.3	36.4	22.2	27.2	31.1	16.3	24.5	26.5
Dibenzofuran	34.8	36.8	40.2	49.7	49.1	59.2	47.2	45.7	55.0	37.8	33.4	40.8	28.3	22.1	28.4	23.9	22.1	23.7	17.9	19.6	24.3
Fluorene	43.1	48.4	43.3	57.4	65.4	58.5	52.8	62.8	55.5	40.2	45.8	42.7	35.0	34.0	26.9	28.1	30.1	29.2	19.5	26.2	23.4
Dibenzothiophene	52.8	50.1	63.3	74.4	71.6	79.1	69.2	68.0	75.9	52.8	51.5	55.3	48.4	36.5	38.7	32.0	35.8	38.0	26.8	25.1	30.0
Phenanthrene	55.2	52.4	75.5	82.4	67.2	109	77.5	63.8	102	61.0	51.7	84.2	51.9	30.9	59.1	35.4	28.2	52.5	33.0	22.2	43.8
Anthracene	69.6	83.0	111	107	109	154	97.4	104	140	80.3	76.5	109	65.3	56.8	73.9	43.9	45.9	73.9	36.4	40.4	61.6
Carbozole	67.4	57.4	69.8	87.5	71.7	90.7	83.2	66.7	85.2	60.4	49.5	67.1	48.1	33.7	42.6	36.8	28.7	37.2	35.0	28.0	38.1
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	39.1	52.8	50.2	52.2	73.3	65.2	49.1	66.7	61.3	36.0	51.3	45.6	32.4	36.6	32.6	24.5	35.2	29.3	17.7	27.1	25.4
2-methylanthracene	24.2	19.7	26.0	35.5	27.0	35.6	33.4	25.7	33.4	24.2	18.4	24.2	19.9	12.2	19.6	16.3	11.3	17.8	13.5	11.3	12.8
1-methylphenanthrene	30.2	24.8	31.9	40.2	35.0	44.3	38.2	33.6	40.3	31.0	25.9	30.5	25.7	16.4	24.3	17.3	14.7	21.2	15.7	12.2	17.3
3,6-dimethylphenanthrene	38.7	42.5	43.7	50.9	56.7	63.4	48.4	53.8	58.9	35.6	40.2	43.1	29.0	26.6	29.8	24.4	28.3	30.4	19.9	23.2	24.7
Fluoranthene	22.5	25.1	34.5	34.2	37.5	44.2	31.4	35.6	41.5	25.3	25.5	30.5	22.2	18.8	19.9	14.3	15.8	22.1	13.0	15.4	16.3
Pyrene	57.4	61.2	61.6	82.0	76.5	94.8	74.7	70.4	86.2	59.1	56.6	68.2	45.9	36.7	49.3	40.2	31.4	46.4	29.5	30.6	37.0
Benzo (a) fluorene	24.9	26.4	33.2	33.2	35.2	43.7	31.8	33.8	40.6	23.9	25.7	31.4	20.2	16.9	20.5	13.6	14.1	17.9	10.9	13.4	17.9
1-methylpyrene	55.2	69.2	57.4	72.6	97.5	83.3	66.0	91.6	79.1	52.3	71.2	56.6	40.6	48.7	42.5	30.5	46.8	37.5	25.4	36.1	32.5
Benzo (a) anthracene	70.8	76.9	101	91.9	117	151	87.3	107	140	68.9	81.6	104	54.2	60.6	78.5	40.4	53.6	69.4	32.2	42.0	52.8
Chrysene	57.1	85.4	95.4	85.2	126	124	81.8	119	113	63.1	89.2	95.4	52.0	59.0	63.2	37.5	56.5	61.9	35.8	44.0	43.4
5-methylchrysene	46.7	49.3	63.2	69.7	74.6	79.0	63.4	71.6	71.9	48.1	51.5	55.3	41.8	33.6	35.6	30.7	34.3	34.8	23.0	26.1	27.7
Benzo (b) fluoranthene	16.1	21.7	29.8	23.7	30.6	44.4	22.3	29.0	41.3	18.0	21.4	32.4	13.0	14.1	23.1	9.71	12.8	21.8	9.48	10.1	18.2
Benzo (k) fluoranthene	60.5	66.2	70.2	78.6	89.5	90.0	75.4	82.3	84.6	54.2	66.2	66.6	50.3	47.4	49.5	38.5	37.6	44.1	32.2	36.7	31.5
Benzo (e) pyrene	16.2	19.3	25.9	24.9	24.1	32.8	23.2	22.0	31.5	18.2	17.6	22.6	14.2	12.3	15.4	12.2	10.4	16.1	10.2	9.17	11.5
Benzo (a) Pyrene	27.2	22.2	34.3	40.7	29.2	47.7	38.2	26.6	45.3	28.9	21.4	32.9	24.0	15.8	22.9	20.3	12.9	21.9	17.1	12.0	19.6
Perylene	45.2	50.6	51.7	65.5	64.1	70.8	61.6	61.5	67.3	45.2	49.3	51.0	36.7	29.5	38.2	32.8	25.6	31.9	26.2	26.9	26.2
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	1167	1325	1449	1647	1792	1998	1473	1595	1787	1133	1236	1389	941	859	978	709	755	885	583	624	721

Table A.9. Summary of the PAH (µg/Kg, dry weight) content in diploid oysters during winter exposure study (continued).

Name	25000 ppm Treatment																				
	Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Naphthalene	81.4	119	81.1	110	147	111	63.8	88.4	64.4	49.5	81.0	56.6	33.0	51.6	36.7	29.0	21.0	27.0	23.0	19.0	17.0
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	127	155	91.5	170	194	122	98.5	113	67.1	95.0	88.0	72.0	57.7	64.0	30.5	45.0	48.0	32.0	28.0	34.0	20.0
Biphenyl	32.2	28.7	28.0	38.8	38.8	37.4	37.7	36.9	34.8	32.2	30.7	29.9	24.1	23.3	20.6	22.9	20.6	19.1	10.1	13.2	8.97
2-ethylnaphthalene	68.9	90.7	54.6	86.1	111	76.9	81.8	103	70.7	62.9	89.6	61.5	53.4	63.1	46.1	40.0	55.0	38.4	25.8	27.7	17.7
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	65.8	88.2	66.7	88.9	109	92.6	81.8	101	85.2	73.8	78.4	69.5	49.8	68.6	58.4	39.0	51.0	51.0	26.7	32.7	21.3
Dibenzofuran	55.0	69.8	74.8	69.6	88.4	94.7	64.1	84.9	88.1	56.4	69.0	76.7	38.3	54.8	58.7	34.8	46.9	48.3	21.6	28.3	33.1
Fluorene	62.0	85.6	69.6	74.7	111	99.4	67.9	107	91.4	58.2	82.3	74.5	42.6	63.4	61.6	35.8	56.0	47.7	31.0	25.6	32.8
Dibenzothiophene	82.3	72.6	99.9	104	93.1	127	96.9	88.4	120	81.2	67.9	99.9	57.3	57.7	74.6	52.0	50.2	65.8	36.0	30.7	36.7
Phenanthrene	92.3	76.3	142	115	107	197	106	102	179	85.4	76.3	159	72.7	60.2	110	54.2	49.4	61.0	26.5	36.5	65.0
Anthracene	120	115	162	161	164	200	146	157	184	120	118	164	99.5	98.3	112	78.0	64.0	71.0	49.0	50.8	66.1
Carbozole	118	88.2	110	158	108	136	145	96.8	125	129	89.3	101	89.8	66.7	76.1	74.0	58.1	61.0	50.4	37.0	43.5
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	66.5	93.8	96.2	88.7	117	117	85.2	107	113	70.1	84.4	83.3	49.7	65.7	69.2	32.0	47.0	59.0	25.7	37.5	27.0
2-methylanthracene	42.1	29.9	40.5	53.3	37.8	53.3	48.0	34.4	49.1	40.0	28.7	42.7	29.9	21.5	30.9	25.6	20.4	28.3	25.0	19.0	27.0
1-methylphenanthrene	41.8	32.7	50.3	52.3	45.5	70.8	50.7	40.9	65.2	42.4	35.9	52.4	31.9	26.8	41.8	24.1	21.4	38.2	18.3	23.0	21.2
3,6-dimethylphenanthrene	49.0	81.6	83.3	66.2	102	114	64.2	94.9	110	53.6	83.6	85.6	37.1	62.2	68.5	33.1	47.0	57.0	27.0	30.6	34.2
Fluoranthene	38.3	49.2	43.6	47.8	60.0	57.4	44.5	55.8	54.0	38.7	48.6	46.5	26.8	34.8	35.0	28.2	30.0	34.5	26.0	29.0	17.2
Pyrene	107	104	102	139	130	133	126	120	121	112	108	99.5	78.1	79.4	82.3	61.0	71.6	66.3	47.4	45.5	46.4
Benzo (a) fluorene	39.5	32.5	53.5	56.4	45.8	74.2	51.9	41.2	68.3	46.2	37.1	53.5	32.7	27.5	41.6	22.0	27.0	34.2	23.0	14.2	24.5
1-methylpyrene	83.8	122	117	109	156	150	101	143	142	77.3	129	106	59.9	95.1	94.4	46.0	50.0	70.0	25.0	51.5	40.5
Benzo (a) anthracene	99.1	131	183	129	186	241	116	179	232	92.6	153	174	78.5	112	152	57.0	65.0	73.0	43.7	63.4	67.6
Chrysene	77.6	119	116	111	163	161	99.7	149	145	87.5	124	118	69.8	91.4	99.9	55.0	78.0	81.0	35.0	45.7	48.3
5-methylchrysene	82.5	73.1	102	111	104	126	108	94.0	120	87.0	79.4	98.6	69.1	60.6	70.8	51.0	41.0	59.4	31.2	34.5	29.1
Benzo (b) fluoranthene	27.7	42.4	48.5	37.9	55.0	62.2	34.9	50.1	59.1	30.7	45.1	51.0	21.6	34.1	37.9	17.8	30.8	35.5	20.0	24.0	14.3
Benzo (k) fluoranthene	99.0	108	108	141	152	135	129	145	131	103	125	98.5	77.8	94.3	85.0	71.0	70.0	81.0	46.7	53.3	39.1
Benzo (e) pyrene	25.5	24.7	39.8	34.9	33.8	52.4	31.4	32.8	50.9	27.6	25.7	37.7	20.2	20.6	28.8	20.6	16.6	30.9	18.0	21.0	25.0
Benzo (a) Pyrene	50.6	34.6	62.7	61.0	46.8	85.8	56.1	45.4	79.0	47.0	38.4	67.0	36.6	27.1	50.6	32.3	26.7	38.6	15.9	12.6	30.0
Perylene	78.0	68.3	74.4	111	83.3	99.2	105	74.9	94.2	81.3	62.5	81.3	66.9	50.8	56.5	45.0	48.3	46.6	26.7	20.0	26.8
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	1914	2136	2302	2526	2791	3027	2240	2485	2743	1881	2079	2260	1405	1576	1731	1126	1211	1356	783	860	880

Table A.10. Summary of the PAH (µg/Kg, dry weight) content in triploid oysters during winter exposure study.

Name	Water Control Treatment																							
	Week 0			Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Naphthalene	3.20	3.85	4.24	3.05	3.70	4.04	2.78	3.40	3.67	2.53	3.10	3.30	2.28	2.62	2.72	1.56	1.94	2.35	1.11	1.12	1.47	1.08	1.16	1.18
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	3.84	4.61	4.90	3.62	4.44	4.63	3.40	4.13	4.26	3.06	3.67	3.92	2.62	3.30	3.45	2.21	2.56	2.38	1.16	1.44	1.32	1.05	1.49	1.74
Biphenyl	0.91	1.07	1.10	0.89	1.04	1.04	0.83	0.95	0.97	0.74	0.89	0.89	0.67	0.77	0.77	0.47	0.59	0.61	0.33	0.31	0.37	0.26	0.31	0.37
2-ethylnaphthalene	2.82	3.19	3.26	2.66	3.04	3.19	2.48	2.76	2.94	2.20	2.49	2.61	1.88	2.27	2.20	1.46	1.71	1.91	0.99	0.94	1.18	0.79	1.19	0.97
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	2.32	2.72	2.79	2.28	2.62	2.63	2.12	2.44	2.50	1.99	2.19	2.35	1.69	1.83	1.85	1.16	1.56	1.40	0.66	0.83	0.83	0.78	0.75	0.85
Dibenzofuran	2.33	2.50	2.81	2.20	2.46	2.75	1.98	2.23	2.48	1.88	2.03	2.33	1.62	1.85	2.03	1.17	1.23	1.36	0.73	0.85	0.89	0.65	0.92	0.92
Fluorene	2.23	2.71	2.93	2.16	2.58	2.82	1.99	2.37	2.65	1.77	2.09	2.52	1.57	1.95	2.07	1.19	1.42	1.69	0.70	0.74	1.01	0.76	0.97	0.82
Dibenzothiophene	2.49	2.98	3.09	2.37	2.87	3.03	2.18	2.70	2.78	2.07	2.45	2.59	1.72	2.18	2.20	1.22	1.73	1.75	0.74	1.08	1.09	0.87	0.92	1.25
Phenanthrene	3.20	3.56	4.34	3.01	3.49	4.10	2.86	3.14	3.89	2.61	2.80	3.58	2.21	2.42	2.96	1.66	1.82	2.18	1.09	1.16	1.52	1.06	1.04	1.24
Anthracene	4.77	5.51	6.69	4.67	5.20	6.31	4.21	4.94	5.87	3.83	4.64	5.52	3.11	4.10	4.46	2.57	2.86	3.40	1.64	1.83	1.99	1.43	1.58	1.99
Carbozole	2.77	3.31	3.61	2.64	3.15	3.40	2.50	2.96	3.06	2.35	2.72	2.69	1.88	2.28	2.54	1.40	1.69	1.96	0.78	0.89	0.95	0.78	1.01	1.35
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	2.96	3.19	3.55	2.85	3.13	3.48	2.70	2.88	3.23	2.49	2.68	3.01	2.16	2.13	2.43	1.76	1.73	2.04	0.84	1.12	1.03	0.87	1.09	1.26
2-methylanthracene	1.07	1.39	1.49	1.05	1.35	1.44	0.99	1.28	1.36	0.91	1.17	1.29	0.78	0.95	1.09	0.55	0.72	0.75	0.36	0.47	0.46	0.35	0.58	0.58
1-methylphenanthrene	1.57	1.87	2.19	1.52	1.83	2.07	1.40	1.68	1.86	1.32	1.55	1.66	1.04	1.28	1.40	0.87	0.96	1.15	0.46	0.54	0.56	0.45	0.67	0.84
3,6-dimethylphenanthrene	2.05	2.45	2.80	2.01	2.40	2.64	1.89	2.26	2.45	1.78	2.10	2.21	1.40	1.85	1.82	1.12	1.44	1.57	0.68	0.88	0.76	0.70	0.99	1.03
Fluoranthene	1.27	1.44	1.56	1.23	1.37	1.52	1.12	1.26	1.38	1.01	1.20	1.29	0.91	0.97	1.11	0.72	0.80	0.82	0.37	0.38	0.44	0.46	0.42	0.47
Pyrene	2.74	2.96	3.87	2.64	2.88	3.68	2.43	2.70	3.31	2.28	2.54	3.02	1.92	2.19	2.58	1.43	1.51	1.89	0.78	1.00	1.26	0.92	0.97	1.19
Benzo (a) fluorene	1.47	1.76	1.82	1.40	1.68	1.75	1.28	1.56	1.64	1.22	1.48	1.53	1.04	1.28	1.25	0.71	0.89	0.90	0.51	0.50	0.61	0.48	0.64	0.64
1-methylpyrene	3.35	3.75	4.02	3.22	3.54	3.94	3.03	3.29	3.62	2.88	3.03	3.30	2.42	2.63	2.83	1.70	1.81	2.21	0.97	1.15	1.27	1.18	1.18	1.12
Benzo (a) anthracene	4.43	4.98	5.50	4.18	4.74	5.39	3.80	4.31	5.13	3.61	3.97	4.82	2.89	3.36	3.79	2.47	2.67	2.82	1.41	1.60	1.54	1.37	1.72	2.15
Chrysene	4.17	4.86	5.13	4.01	4.72	4.84	3.69	4.34	4.36	3.39	3.95	4.14	2.91	3.30	3.27	2.36	2.61	2.53	1.22	1.74	1.52	1.18	1.61	1.52
5-methylchrysene	3.48	3.34	3.72	3.32	3.28	3.54	3.05	3.08	3.36	2.81	2.74	3.16	2.50	2.31	2.49	1.80	1.79	1.95	1.04	1.20	1.04	1.04	1.11	1.38
Benzo (b) fluoranthene	1.32	1.46	1.65	1.27	1.39	1.60	1.15	1.26	1.45	1.04	1.20	1.34	0.93	1.00	1.19	0.70	0.78	0.81	0.42	0.47	0.54	0.48	0.38	0.60
Benzo (k) fluoranthene	2.63	3.12	3.52	2.56	3.00	3.45	2.43	2.85	3.27	2.16	2.71	2.91	1.80	2.16	2.42	1.36	1.62	1.83	0.95	1.08	1.02	1.09	1.20	1.02
Benzo (e) pyrene	1.03	1.17	1.33	1.00	1.14	1.31	0.92	1.07	1.23	0.83	0.97	1.17	0.69	0.82	0.99	0.54	0.63	0.76	0.31	0.32	0.42	0.28	0.45	0.50
Benzo (a) Pyrene	1.50	1.72	1.93	1.42	1.67	1.84	1.32	1.50	1.75	1.21	1.41	1.57	1.04	1.22	1.34	0.82	0.98	0.99	0.43	0.56	0.61	0.47	0.57	0.59
Perylene	2.29	2.56	2.75	2.16	2.51	2.67	2.01	2.38	2.48	1.89	2.22	2.33	1.49	1.93	1.88	1.23	1.48	1.36	0.72	0.76	0.84	0.74	0.93	0.74
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	68.2	78.0	86.6	65.4	75.2	83.1	60.5	69.7	77.0	55.9	64.0	71.0	47.2	55.0	59.1	36.2	41.5	45.4	21.4	24.9	26.5	21.6	25.8	28.3

Table A.10. Summary of the PAH (µg/Kg, dry weight) content in triploid oysters during winter exposure study (continued).

Name	Sediemnt Control Treatment																				
	Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Naphthalene	3.25	4.05	4.26	2.73	3.44	3.62	2.86	3.24	3.66	2.24	2.96	2.77	2.08	2.47	2.60	1.66	2.19	2.30	0.71	1.03	0.91
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	4.08	4.74	5.06	3.59	4.08	4.36	3.39	3.94	4.15	2.82	3.51	3.80	2.33	2.94	2.94	2.41	2.47	2.89	0.90	1.06	1.35
Biphenyl	1.00	1.10	1.13	0.87	0.95	0.99	0.82	0.93	0.94	0.70	0.80	0.79	0.64	0.66	0.70	0.55	0.59	0.68	0.27	0.26	0.35
2-ethylnaphthalene	2.87	3.18	3.38	2.53	2.77	2.91	2.30	2.77	2.94	1.98	2.16	2.43	1.81	2.03	1.89	1.44	1.59	1.89	0.81	0.94	0.81
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	2.52	2.92	2.93	2.19	2.48	2.46	2.17	2.60	2.55	1.74	1.90	2.20	1.61	1.78	1.64	1.41	1.58	1.49	0.61	0.75	0.86
Dibenzofuran	2.33	2.66	2.88	2.01	2.31	2.50	1.91	2.18	2.50	1.68	1.86	2.01	1.42	1.54	1.58	1.28	1.33	1.64	0.62	0.58	0.73
Fluorene	2.31	2.85	3.15	1.96	2.45	2.68	2.01	2.56	2.80	1.64	2.14	2.27	1.34	1.79	1.92	1.18	1.51	1.70	0.55	0.78	0.83
Dibenzothiophene	2.61	3.10	3.26	2.22	2.63	2.74	2.14	2.51	2.77	1.80	2.08	2.35	1.46	1.95	1.79	1.39	1.70	1.63	0.64	0.92	0.77
Phenanthrene	3.35	3.71	4.67	2.85	3.22	4.11	2.78	3.04	4.01	2.45	2.59	3.45	2.04	2.08	2.66	1.88	1.93	2.43	0.91	0.81	1.07
Anthracene	4.84	5.73	6.81	4.11	5.04	5.92	3.87	4.87	6.06	3.14	3.84	4.49	2.81	3.32	4.08	2.56	3.44	3.54	1.23	1.71	1.95
Carbozole	2.95	3.43	3.64	2.60	2.88	3.06	2.42	2.88	2.91	2.22	2.51	2.62	1.63	2.13	2.19	1.57	1.96	1.89	0.78	0.87	0.92
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	3.24	3.46	3.82	2.76	3.01	3.32	2.92	3.04	3.05	2.17	2.32	2.86	2.11	1.97	2.14	1.72	2.04	2.29	0.69	0.90	1.03
2-methylanthracene	1.14	1.52	1.56	0.97	1.34	1.37	0.96	1.36	1.26	0.75	1.04	1.06	0.71	0.88	0.89	0.67	0.79	0.84	0.33	0.44	0.45
1-methylphenanthrene	1.63	1.95	2.18	1.41	1.66	1.85	1.40	1.72	1.77	1.06	1.39	1.61	0.93	1.13	1.31	0.93	1.04	1.26	0.41	0.55	0.63
3,6-dimethylphenanthrene	2.21	2.66	2.82	1.90	2.29	2.43	1.97	2.21	2.29	1.66	1.89	2.06	1.26	1.60	1.81	1.33	1.41	1.61	0.48	0.69	0.80
Fluoranthene	1.31	1.45	1.62	1.10	1.22	1.36	1.06	1.20	1.29	0.93	0.99	1.20	0.75	0.81	0.97	0.79	0.77	0.94	0.29	0.38	0.48
Pyrene	2.89	3.22	3.98	2.54	2.83	3.50	2.54	2.67	3.18	2.11	2.22	2.78	1.85	2.03	2.23	1.73	1.71	2.07	0.69	0.85	1.12
Benzo (a) fluorene	1.50	1.83	1.89	1.26	1.61	1.59	1.31	1.59	1.62	1.04	1.31	1.34	0.96	1.11	1.11	0.87	0.91	1.10	0.35	0.55	0.51
1-methylpyrene	3.58	3.78	4.17	3.00	3.25	3.50	2.97	3.10	3.71	2.47	2.46	3.04	2.22	2.08	2.50	1.97	2.12	2.25	0.78	0.81	0.94
Benzo (a) anthracene	4.56	5.17	6.05	3.97	4.45	5.20	3.70	4.14	4.96	3.24	3.73	4.23	2.69	3.16	3.57	2.37	3.00	3.27	1.19	1.42	1.77
Chrysene	4.24	5.21	5.10	3.60	4.48	4.38	3.69	4.33	4.49	2.97	3.60	3.77	2.59	3.13	3.06	2.16	3.08	3.06	0.94	1.57	1.18
5-methylchrysene	3.51	3.57	3.97	3.09	3.00	3.33	2.98	2.93	3.25	2.35	2.54	2.82	2.03	2.29	2.26	2.00	2.04	2.22	1.05	0.81	0.83
Benzo (b) fluoranthene	1.34	1.52	1.67	1.17	1.33	1.44	1.21	1.33	1.34	0.90	1.03	1.09	0.75	0.88	0.99	0.67	0.89	0.97	0.31	0.39	0.45
Benzo (k) fluoranthene	2.84	3.39	3.83	2.44	2.98	3.37	2.53	2.78	3.22	2.05	2.41	2.68	1.79	2.10	2.26	1.54	1.73	1.99	0.86	0.95	1.18
Benzo (e) pyrene	1.09	1.25	1.46	0.94	1.10	1.27	0.94	1.08	1.24	0.78	0.94	1.08	0.60	0.76	0.83	0.56	0.73	0.77	0.29	0.32	0.34
Benzo (a) Pyrene	1.54	1.73	2.06	1.29	1.45	1.81	1.36	1.42	1.83	1.03	1.28	1.50	0.99	1.04	1.30	0.86	1.04	1.17	0.36	0.39	0.53
Perylene	2.41	2.74	2.85	2.03	2.30	2.42	2.12	2.19	2.54	1.57	2.00	1.85	1.33	1.65	1.63	1.35	1.51	1.51	0.53	0.64	0.82
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	71.2	81.9	90.2	61.1	70.6	77.5	60.3	68.6	76.3	49.5	57.5	64.2	42.7	49.3	52.8	38.8	45.1	49.4	17.6	21.4	23.6

Table A.10. Summary of the PAH (µg/Kg, dry weight) content in triploid oysters during winter exposure study (continued).

Name	500 ppm Treatment																				
	Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Naphthalene	19.2	23.9	25.1	28.8	31.1	32.7	18.1	20.5	19.6	10.9	11.5	9.8	10.6	9.3	9.8	8.9	7.1	6.5	6.1	4.8	5.0
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	23.7	26.6	29.4	30.8	31.9	44.1	21.5	22.0	27.3	10.5	11.5	17.2	9.2	11.5	13.7	10.3	8.1	7.2	6.4	5.1	4.5
Biphenyl	5.49	6.36	6.57	7.68	8.91	9.20	6.99	7.84	8.74	5.15	6.06	6.72	4.92	5.88	5.61	3.00	2.67	3.31	3.00	2.94	3.59
2-ethylnaphthalene	14.4	16.2	19.3	17.2	21.1	27.0	16.0	19.4	25.6	12.1	15.2	18.3	10.9	14.5	18.9	6.21	8.43	10.0	6.38	7.59	9.70
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	14.4	16.7	15.5	17.2	20.0	23.3	15.2	18.0	21.0	11.9	14.8	17.0	12.1	12.8	14.9	6.72	6.80	8.15	6.03	7.80	7.45
Dibenzofuran	14.0	13.8	16.4	21.0	16.6	19.7	19.7	15.3	18.5	15.7	11.8	14.0	13.0	10.6	13.8	8.40	5.14	6.49	6.72	5.14	7.47
Fluorene	13.4	16.5	18.0	17.4	23.1	23.3	15.3	21.7	21.2	12.2	15.7	17.3	10.8	15.5	14.7	6.27	8.79	7.70	5.74	8.79	8.87
Dibenzothiophene	13.1	17.4	17.3	19.6	26.0	24.2	18.0	22.9	21.5	14.7	18.5	16.9	13.3	15.9	16.2	6.47	7.81	8.70	7.26	9.63	7.25
Phenanthrene	19.4	18.9	23.3	25.3	22.7	35.0	22.2	21.1	31.2	17.2	16.8	25.6	15.4	15.0	24.2	8.08	8.39	11.2	8.34	8.17	11.6
Anthracene	28.5	32.1	37.4	34.2	38.5	44.9	31.5	35.4	41.3	24.7	27.3	33.2	24.0	23.1	29.6	13.7	13.5	15.3	13.0	15.4	17.5
Carbozole	16.5	17.2	18.6	24.8	20.6	24.2	22.8	18.3	21.5	18.6	14.4	17.2	15.6	12.8	16.4	9.93	7.21	7.25	7.94	6.18	8.94
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	17.8	20.1	20.2	25.0	24.1	30.3	23.0	21.4	27.6	18.5	17.6	21.5	15.5	14.7	20.6	7.49	7.22	11.5	8.49	8.66	10.3
2-methylanthracene	6.61	7.62	8.59	8.59	9.14	12.0	8.07	8.50	11.1	5.93	6.22	8.42	5.15	6.40	8.30	2.58	3.02	4.57	2.92	2.93	4.45
1-methylphenanthrene	9.59	10.5	12.6	13.4	13.7	15.2	12.6	12.3	13.5	9.27	9.60	10.2	9.13	8.78	9.86	4.43	4.66	5.92	5.37	4.25	4.85
3,6-dimethylphenanthrene	12.8	14.4	16.7	16.7	17.2	23.3	15.0	16.2	20.5	11.7	11.9	17.3	10.8	11.4	14.0	6.67	6.21	6.99	5.34	5.17	9.09
Fluoranthene	6.57	8.27	8.41	8.5	12.4	10.9	7.69	11.3	9.6	6.23	8.69	8.20	5.72	8.31	7.44	3.07	4.96	3.50	2.90	3.85	3.39
Pyrene	14.4	17.7	23.5	21.7	23.0	32.8	19.5	21.6	29.6	15.8	15.4	23.0	13.9	14.0	21.3	6.93	7.13	12.5	6.71	6.90	11.5
Benzo (a) fluorene	8.11	9.67	10.0	9.73	14.5	12.0	9.2	13.8	10.8	6.91	10.2	8.05	6.04	9.29	7.57	3.50	5.08	3.96	2.92	5.80	4.44
1-methylpyrene	19.3	21.2	25.0	23.2	31.8	35.0	21.3	29.2	31.1	16.2	23.2	24.8	14.1	20.0	23.1	8.57	9.53	11.5	8.1	10.5	11.9
Benzo (a) anthracene	27.4	28.5	30.8	38.3	34.1	43.2	36.0	30.1	38.9	26.1	24.9	29.4	23.4	22.5	26.8	13.8	10.6	14.7	11.5	12.3	14.2
Chrysene	22.9	31.3	26.0	34.3	40.7	31.2	31.9	37.4	29.0	25.4	27.6	21.5	23.7	26.8	19.7	10.3	15.4	12.5	10.6	12.2	11.9
5-methylchrysene	17.5	18.6	19.8	21.0	24.2	27.8	20.0	21.7	24.4	15.6	16.2	20.8	12.8	15.7	19.2	6.73	9.18	10.56	7.15	8.46	9.17
Benzo (b) fluoranthene	6.97	7.73	8.86	9.06	10.1	12.4	8.33	9.35	11.4	6.70	7.24	8.56	6.25	7.04	8.56	2.99	3.62	3.84	3.44	3.42	3.84
Benzo (k) fluoranthene	17.1	19.3	21.8	23.9	27.0	28.4	22.0	24.1	26.4	16.7	18.7	20.2	14.8	17.9	17.0	8.12	10.0	9.9	7.16	10.8	10.5
Benzo (e) pyrene	5.90	6.75	8.47	8.26	10.1	12.7	7.26	9.32	11.7	5.61	7.59	8.77	5.53	6.28	8.13	3.05	3.95	5.08	3.30	3.04	4.32
Benzo (a) Pyrene	8.78	9.67	11.5	10.5	13.5	17.3	9.38	12.9	16.4	7.48	9.89	12.8	7.16	9.07	10.6	3.37	5.28	5.71	3.69	4.47	6.05
Perylene	13.3	15.1	17.1	19.9	18.1	22.2	17.9	16.3	20.5	13.3	12.8	15.8	12.1	11.8	14.9	6.37	6.15	7.34	7.57	6.33	8.23
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	397	452	496	536	584	674	477	518	590	361	391	452	326	357	415	186	196	222	174	191	220

Table A.10. Summary of the PAH (µg/Kg, dry weight) content in triploid oysters during winter exposure study (continued).

Name	5000 ppm Treatment																				
	Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Naphthalene	66.5	75.0	73.3	97.8	109	108	55.7	56.5	57.1	40.1	54.3	46.4	32.3	41.3	38.8	20.0	24.3	26.4	12.3	21.3	18.8
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	84.2	82.6	100.3	111	115	145	67.6	57.4	77.1	47.6	56.2	61.1	38.8	41.3	50.9	27.6	16.2	31.4	18.9	11.3	20.9
Biphenyl	20.9	25.7	24.2	26.1	32.1	32.2	23.8	30.1	29.3	19.3	24.1	22.9	15.7	15.4	14.5	11.5	13.2	14.8	9.7	12.8	13.5
2-ethylnaphthalene	46.5	55.3	66.6	65.5	80.1	102.4	62.2	74.5	93.2	45.2	61.7	78.9	39.3	40.8	53.3	31.4	36.8	48.1	22.9	31.2	41.0
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	43.4	47.6	59.5	60.3	70.0	83.8	55.5	67.2	76.3	43.4	49.0	60.3	38.6	33.6	45.3	27.1	33.6	34.4	22.9	28.7	33.5
Dibenzofuran	61.4	39.5	56.0	77.7	58.1	72.8	73.0	55.2	69.1	55.1	40.6	50.9	42.7	27.9	33.5	31.1	23.2	29.1	31.1	22.1	27.7
Fluorene	40.8	54.3	70.1	57.4	78.6	88.7	55.1	71.6	82.5	39.1	59.8	63.9	34.5	36.2	44.4	27.0	31.5	39.9	20.7	29.9	33.7
Dibenzothiophene	52.2	69.4	64.4	68.6	93.7	87.0	64.5	89.0	83.5	48.7	64.7	60.0	43.2	51.6	43.5	32.3	45.0	42.6	27.5	32.8	30.5
Phenanthrene	60.0	56.4	104	83.4	79.4	130	80.0	72.3	122	62.5	56.4	98.5	50.0	39.7	70.0	35.0	31.8	63.5	32.5	33.3	46.6
Anthracene	81.5	110	105	116	146	157	109	136	146	86.2	105.3	113.2	73.4	73.1	81.8	47.7	61.4	72.3	39.6	49.7	64.5
Carbozole	64.3	59.3	62.4	89.4	74.2	82.1	83.1	67.5	74.7	65.2	54.1	56.7	58.1	39.3	39.4	35.7	31.9	40.2	32.2	28.9	29.6
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	60.3	67.7	68.1	84.9	89.0	103.2	79.0	83.7	98.0	62.9	60.5	74.3	51.8	42.7	49.5	35.7	35.6	46.4	34.0	31.2	38.2
2-methylanthracene	18.7	23.5	29.4	28.3	30.2	40.9	26.1	28.1	39.2	21.5	22.0	29.8	17.3	15.4	21.7	12.8	13.9	19.6	9.9	12.7	16.8
1-methylphenanthrene	32.0	32.2	36.5	47.0	46.6	56.1	43.7	42.4	53.9	35.7	33.6	42.1	30.6	22.4	25.3	20.2	19.1	24.1	16.5	15.9	20.8
3,6-dimethylphenanthrene	42.5	49.1	67.3	63.4	65.5	86.3	59.6	62.2	81.1	48.8	48.5	59.5	36.1	32.1	38.8	31.1	32.8	36.2	24.1	26.2	34.5
Fluoranthene	22.5	27.4	28.6	28.2	40.9	37.2	27.1	38.5	35.7	19.4	31.1	25.3	17.8	18.8	19.3	12.4	17.2	18.2	10.4	15.2	12.3
Pyrene	52.2	57.9	80.2	78.0	78.2	108	74.1	73.5	101	60.0	58.7	81.3	48.3	41.5	52.0	38.2	37.5	43.4	32.7	27.4	41.2
Benzo (a) fluorene	20.9	34.5	35.1	32.1	47.9	44.4	30.2	44.5	42.2	24.7	35.9	32.4	19.3	26.3	21.8	14.1	21.1	20.0	11.6	15.8	15.1
1-methylpyrene	52.0	70.2	89.2	78.8	108	119	74.1	104	113	59.1	76.7	91.6	44.9	50.8	59.5	37.8	49.7	51.2	29.9	37.8	46.4
Benzo (a) anthracene	87.2	90.8	117	134	120	147	125	111	138	97.9	81.3	113	81.8	64.5	70.5	57.7	55.0	61.7	55.0	45.4	48.4
Chrysene	84.1	116	72.1	124	146	103	114	136	97.8	90.2	111.2	75.2	68.0	80.5	53.5	53.1	70.3	47.4	40.8	49.8	42.2
5-methylchrysene	46.5	59.2	71.9	69.4	84.6	103	65.3	80.3	96.6	53.5	60.9	74.0	41.0	42.3	48.3	33.3	37.2	47.3	29.2	28.8	36.0
Benzo (b) fluoranthene	27.2	22.2	28.2	34.4	33.2	40.9	33.0	31.2	39.3	23.8	25.5	29.9	20.7	17.6	21.3	15.5	14.6	17.2	11.7	13.6	13.5
Benzo (k) fluoranthene	69.8	67.2	66.5	88.4	97.4	93.7	83.1	92.5	86.2	66.3	72.1	69.3	50.4	44.8	45.9	36.2	38.9	39.3	33.6	36.0	38.4
Benzo (e) pyrene	20.5	27.2	27.3	28.1	34.4	41.9	26.7	33.0	40.3	20.5	24.1	29.4	16.0	17.6	22.6	12.6	14.8	20.6	10.7	13.4	14.7
Benzo (a) Pyrene	26.9	32.6	40.0	37.9	44.7	58.8	36.4	40.7	55.9	29.2	31.3	45.3	21.2	24.6	28.2	18.6	20.1	26.5	13.7	18.8	21.8
Perylene	44.0	45.4	53.7	67.7	68.8	75.6	65.0	66.0	72.6	49.4	48.1	52.9	39.3	33.0	38.6	27.8	33.7	36.3	25.1	23.4	28.0
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	1329	1497	1697	1878	2071	2348	1692	1845	2101	1316	1448	1638	1071	1015	1132	784	860	998	659	713	828

Table A.10. Summary of the PAH (µg/Kg, dry weight) content in triploid oysters during winter exposure study (continued).

Name	25000 ppm Treatment																				
	Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7		
Naphthalene	119	108	126	156	152	173	150	143	159	87.6	88.3	109	58.2	45.9	36.6	43.8	48.7	58.7	24.0	29.0	19.0
Benzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	124	138	131	177	172	174	163	158	157	103	103	99.4	68.1	75.8	70.5	62.1	39.6	55.8	30.0	21.0	36.0
Biphenyl	30.6	34.1	38.7	39.2	44.9	51.5	37.6	42.7	50.0	31.7	33.7	41.2	22.7	27.4	31.4	19.3	21.6	23.9	9.01	12.1	16.5
2-ethylnaphthalene	65.1	104	125	91.7	128	174	82.5	115	169	65.1	93.5	125	50.4	79	103	37.1	53.3	52.2	28.4	30.8	48.8
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	54.3	88.4	104	72.4	112	126	70.2	106	121	54.3	85.1	94.3	44.1	61.6	74.2	41.3	46.4	54.8	18.1	38.1	39.0
Dibenzofuran	70.8	58.9	65.5	93.2	75.5	87.3	87.6	71.7	84.7	72.7	56.6	65.5	55.9	42.3	50.6	39.6	29.5	42.0	26.1	20.4	29.7
Fluorene	78.1	94.4	91.1	97.6	118	115	94.7	110	107	71.3	93.2	81.9	59.6	73.1	64.6	44.2	40.5	41.8	23.4	34.2	31.1
Dibenzothiophene	67.5	126	100	82.4	159	139	76.6	148	135	62.6	132	110	49.4	95.6	76.6	35.6	46.8	45.4	28.8	36.7	40.4
Phenanthrene	82.9	75.3	165	117	103	220	111	93.9	214	91.0	82.6	178	68.9	61.9	128	52.1	52.6	62.5	31.5	31.0	61.7
Anthracene	158	184	191	198	249	236	182	226	222	143	177	170	123	157	130	72.0	54.9	57.9	61.4	82.0	56.6
Carbozole	87	99	99	107	119	123	96.5	108	113	84.7	86.6	93.6	60.0	66.5	67.8	47.9	45.4	50.3	37.5	28.5	38.2
4-methylbenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-methylphenanthrene	107	103	123	144	142	175	133	131	160	118	107	140	82.3	86.9	107	58.2	64.1	62.1	44.8	49.9	45.6
2-methylanthracene	31.9	33.4	44.1	42.5	42.2	57.2	38.3	39.3	53.2	34.0	32.5	40.6	26.4	26.6	36.1	22.6	21.3	30.4	9.78	12.7	17.7
1-methylphenanthrene	44.6	60.2	68.2	61.1	79.3	84.2	59.3	76.9	80.8	50.7	59.4	66.5	35.4	49.1	48.0	26.1	31.0	43.9	20.8	20.6	29.5
3,6-dimethylphenanthrene	83.0	76.5	113	108	105	147	105	97.5	136	87.3	78.6	104	66.8	65.0	90.9	46.6	46.7	35.6	33.4	28.3	49.9
Fluoranthene	31.6	53.7	48.0	39.5	65.5	63.2	35.9	59.6	60.7	32.7	51.1	51.2	22.9	36.0	39.2	21.7	30.6	26.2	12.2	15.7	20.2
Pyrene	81.9	66.6	108	117	93.9	152	113	86.4	143	97.1	66.6	118	70.2	59.1	89.5	58.9	42.1	50.4	29.2	24.4	37.9
Benzo (a) fluorene	39.5	53.6	42.7	48.2	76.6	53.3	46.3	73.6	50.1	35.2	57.5	38.4	28.9	46.7	33.6	20.6	36.1	20.4	13.5	23.8	14.9
1-methylpyrene	98.1	118	104	118	151	143	115	141	129	85.1	120	101	72.1	83.2	80.0	59.6	61.1	66.9	33.1	34.8	44.3
Benzo (a) anthracene	129	119	156	174	167	191	159	161	176	139	129	139	97.6	100	116	81.0	60.4	69.7	48.8	53.5	53.4
Chrysene	124	166	119	161	205	154	156	199	147	124	160	122	101	113	86.5	68.7	71.3	58.5	41.8	59.4	37.1
5-methylchrysene	64.2	112	143	83.3	144	175	78	134	162	61	104	138	48	82	97.8	45.4	44.2	54.8	19.2	41.7	57.7
Benzo (b) fluoranthene	36.7	37.6	45.4	44.8	46.4	61.4	40.7	42.3	58.9	32.7	33.9	49.7	26.4	25.5	36.2	20.8	21.6	28.4	14.3	11.6	15.3
Benzo (k) fluoranthene	95.4	125	100	133	156	122	127	143	118	107	120	101	74.2	95.0	69.4	47.9	52.2	56.7	46.4	45.2	32.9
Benzo (e) pyrene	28.8	34.2	53.5	36.5	48.2	71.3	33.2	46.7	64.9	27.0	40.0	57.0	22.6	29.4	44.2	20.1	19.9	38.5	10.9	13.0	19.3
Benzo (a) Pyrene	39.8	53.9	70.6	56.9	76.0	94.1	51.2	70.7	85.6	41.5	53.9	78.1	32.4	46.3	55.5	31.4	40.6	36.4	19.3	22.0	26.3
Perylene	87.5	59.4	72.6	115	82.5	90.7	104	75.9	84.4	95.6	58.6	66.2	67.9	49.5	57.2	30.4	37.1	40.0	32.2	22.3	27.2
Indeno (1,2,3 - cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzo (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo (g,h,i) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ΣPAH	2060	2381	2648	2715	3114	3453	2546	2901	3240	2035	2302	2581	1535	1780	1920	1155	1160	1264	748	843	946

Table A.11. Summary of water quality field results for Bay Jimmy and Grand Isle sites.

Date	Site ID	Water Temperature (°C)	Specific Conductance (µS/cm)	Wind Speed (mph)	Wind Direction (degrees)	Salinity (‰)	Dissolved Oxygen (mg/L)	pH	Turbidity (NTU)
7/28/2011	BJ#1	29.4	13900	9.6	180	8.00	3.8	6.41	198
	BJ#2	30.1	12510	7.7	180	6.80	4.0	6.28	166
	BJ#3	28.9	13761	10	164	8.48	3.9	6.73	192
	Avg.	29.5	13390	9.2	175	7.76	3.9	6.47	185
	STDEV	0.6	766	1.3	9.35	0.87	0.1	0.2	16.8
	GI#1	29.1	28000	7.7	182	17.2	3.0	6.35	175
	GI#2	30.2	26510	9.2	198	15.3	3.8	6.73	160
	GI#3	29.6	25930	9.2	189	16.8	3.5	6.28	152
	Avg.	29.6	26813	8.7	190	16.4	3.5	6.45	162
	STDEV	0.6	1068	0.9	8.12	1.0	0.4	0.24	11.6
9/16/2011	BJ#1	27.2	9280	5.9	162	5.23	4.1	7.22	258
	BJ#2	26.7	9373	5.6	157	5.13	4.2	7.51	250
	BJ#3	28.6	9558	5.5	149	4.97	4.1	6.86	268
	Avg.	27.5	9404	5.7	156	5.11	4.1	7.20	259
	STDEV	1.0	142	0.2	6.55	0.13	0.1	0.33	9.06
	GI#1	27.4	30500	6.1	162	18.9	4.1	6.79	201
	GI#2	27.2	29230	6.0	157	17.6	4.3	7.36	185
	GI#3	26.9	28940	6.1	168	18.1	3.9	7.29	179
	Avg.	27.2	29557	6.0	163	18.2	4.1	7.15	188
	STDEV	0.2	830	0.1	5.69	0.66	0.2	0.31	11.4
11/21/2011	BJ#1	21.3	34100	7.8	109	21.4	4.9	6.87	124
	BJ#2	21.7	35805	7.7	113	21.2	5.0	7.01	131
	BJ#3	20.2	32736	8.2	109	21.0	5.1	7.08	119
	Avg.	21.1	34214	7.9	110	21.2	5.0	6.98	125
	STDEV	0.8	1538	0.3	2.52	0.21	0.1	0.10	6.24
	GI#1	21.5	41600	7.9	110	26.7	5.0	6.87	112
	GI#2	21.8	40320	8.1	113	25.8	4.9	7.08	109
	GI#3	21.1	40560	7.4	107	27.1	5.0	7.21	95.3
	Avg.	21.5	40827	7.8	110	26.5	5.0	7.05	105
	STDEV	0.4	680	0.4	3.27	0.67	0.1	0.17	8.80

Table A.11. Summary of water quality field results for Bay Jimmy and Grand Isle sites (continued).

Date	Site ID	Water Temperature (°C)	Specific Conductance (µS/cm)	Wind Speed (mph)	Wind Direction (degrees)	Salinity (‰)	Dissolved Oxygen (mg/L)	pH	Turbidity (NTU)
2/28/2012	BJ#1	14.0	5280	17	352	2.81	5.2	6.95	125
	BJ#2	14.4	5280	16	341	2.78	5.5	6.81	132
	BJ#3	13.7	5069	19	359	2.92	5.4	6.88	118
	Avg.	14.0	5210	17.5	351	2.8	5.4	6.88	125
	STDEV	0.4	122	1.3	8.86	0.1	0.1	0.07	7.00
	GI#1	16.6	34600	18	338	21.8	5.1	7.23	87.3
	GI#2	16.8	35210	13	370	20.5	5.0	6.88	99.2
	GI#3	17.3	34150	17	348	19.8	5.5	7.02	108
	Avg.	16.9	34653	15.8	352	20.7	5.2	7.04	98.2
	STDEV	0.4	532	2.4	16.1	1.0	0.2	0.17	10.4
5/30/2012	BJ#1	29.0	14800	9.2	234	8.63	6.3	7.12	167
	BJ#2	28.7	14208	8.8	241	8.72	6.6	7.33	174
	BJ#3	27.8	15096	9.7	236	8.72	6.1	7.12	165
	Avg.	28.5	14701	9.2	237	8.7	6.3	7.19	169
	STDEV	0.6	452	0.4	3.57	0.05	0.2	0.12	4.4
	GI#1	26.5	29600	8.9	243	16.8	6.2	7.26	152
	GI#2	27.7	28420	9.2	222	15.2	6.4	7.48	162
	GI#3	28.1	27960	9.4	243	15.9	6.4	7.26	139
	Avg.	27.9	28190	9.3	233	15.6	6.4	7.37	150
	STDEV	0.3	325	0.1	14.9	0.49	0.0	0.15	16.3
8/23/2012	BJ#1	28.5	18200	12	139	10.7	4.5	6.45	244
	BJ#2	28.8	16900	11	145	11.1	4.5	6.45	232
	BJ#3	27.1	18551	11	139	10.3	4.5	6.13	242
	Avg.	28.1	17884	11.3	141	10.7	4.5	6.34	239
	STDEV	0.9	870	0.6	3.21	0.4	0.0	0.19	6.5
	GI#1	28.1	36600	12	132	23.1	4.6	6.19	213
	GI#2	28.6	35840	11	133	22.8	4.6	6.39	206
	GI#3	28.3	33590	15	133	23.4	4.5	6.51	191
	Avg.	28.3	35343	12.9	133	23.1	4.6	6.36	180
	STDEV	0.3	1565	2.1	0.80	0.30	0.0	0.16	11.2

Table A.11. Summary of water quality field results for Bay Jimmy and Grand Isle sites (continued).

Date	Site ID	Water Temperature (°C)	Specific Conductance (µS/cm)	Wind Speed (mph)	Wind Direction (degrees)	Salinity (‰)	Dissolved Oxygen (mg/L)	pH	Turbidity (NTU)
9/7/2012	BJ#1	27.9	25500	14	57.0	15.5	3.6	7.03	307
	BJ#2	29.0	26520	14	54.2	15.0	3.7	7.17	295
	BJ#3	28.7	26010	14	57.6	15.0	3.8	6.75	313
	Avg.	28.6	26010	14.0	56.2	15.2	3.7	6.98	305
	STDEV	0.6	510	0.4	1.83	0.3	0.1	0.21	9.38
	GI#1	29.1	37100	13	58.7	23.4	3.7	7.03	223
	GI#2	28.8	36920	15	59.3	23.3	3.6	6.82	251
	GI#3	29.3	37840	14	59.3	22.8	3.5	7.17	239
	Avg.	29.1	37287	14.1	59.1	23.2	3.6	7.01	238
	STDEV	0.3	488	0.7	0.33	0.32	0.1	0.18	14.0

Table A.12. Summary of raw results (µg/Kg, dry wt) for sediments - July 2011.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	2.37	3.61	3.52	5.33	4.33	4.66	5.49	4.99	5.25	4.62	2.76	3.76	3.45	4.52	3.89	1.17	1.56	0.99
Benzothiophene	1.17	0.00	0.00	0.00	0.00	0.00	0.00	1.95	0.00	0.00	1.10	0.00	1.41	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	3.43	2.55	2.58	3.79	3.37	3.56	3.46	4.46	2.69	3.26	3.57	2.69	4.12	2.60	3.75	0.59	0.96	0.60
Biphenyl	12.8	16.4	9.29	12.2	12.0	11.2	17.1	15.1	17.3	12.6	8.27	9.96	12.5	16.1	12.0	0.00	0.00	0.00
2-ethylnaphthalene	6.50	6.16	4.70	6.82	6.06	6.20	7.33	7.21	8.63	4.71	5.85	6.76	8.80	7.35	5.97	0.00	0.00	0.00
Acenaphthylene	1.71	0.00	0.00	0.00	0.00	0.00	0.00	2.59	0.00	0.00	1.86	0.00	2.15	0.00	0.00	0.00	0.00	0.00
Acenaphthene	4.40	4.74	4.18	6.11	4.95	5.14	5.35	5.76	5.20	5.41	5.18	4.01	4.06	7.16	6.20	0.00	0.00	0.00
Dibenzofuran	6.99	13.0	7.48	12.1	11.5	12.9	14.5	10.7	11.1	8.53	9.87	6.38	7.67	14.9	11.3	0.41	0.35	0.32
Fluorene	5.34	5.17	3.37	5.50	5.19	5.63	5.21	6.48	5.39	3.93	2.79	5.42	5.77	6.50	4.33	1.16	1.05	0.95
Dibenzothiophene	3.56	6.71	3.57	6.31	5.53	6.65	6.93	5.19	5.73	4.22	4.91	3.27	4.08	7.48	5.18	0.89	0.79	0.63
Phenanthrene	12.4	16.2	13.4	17.2	15.1	16.8	20.4	22.9	23.5	15.8	18.3	16.3	17.2	18.6	14.6	1.78	1.75	1.21
Anthracene	0.94	1.29	1.42	1.45	1.25	1.62	1.48	1.37	1.69	1.28	1.01	1.17	1.43	1.47	1.65	0.45	0.36	0.30
Carbozole	6.27	5.12	6.53	10.0	8.43	11.1	9.10	9.01	7.91	8.01	5.04	7.97	7.99	7.44	8.69	0.00	0.00	0.00
4-methyldibenzothiophene	9.62	7.25	7.19	15.5	13.7	19.8	16.1	22.1	11.4	11.0	9.97	9.05	15.0	10.5	9.44	0.00	0.00	0.00
2-methylphenanthrene	26.8	15.4	23.9	30.6	28.0	33.6	33.4	37.8	24.7	19.3	28.9	20.8	32.8	20.5	28.7	1.15	1.02	1.06
2-methylanthracene	14.6	10.1	14.5	15.5	14.0	15.2	18.9	19.0	18.4	13.8	11.0	16.2	15.6	15.4	17.1	0.00	0.00	0.00
1-methylphenanthrene	29.6	27.0	31.1	44.9	37.2	53.6	36.4	49.8	50.6	38.6	27.7	29.2	50.3	38.3	40.0	0.00	0.00	0.00
3,6-dimethylphenanthrene	21.0	31.8	21.0	41.1	36.8	40.3	36.8	31.1	37.3	30.4	30.7	30.5	29.7	38.3	27.9	1.44	0.99	0.99
Fluoranthene	13.9	12.3	11.4	16.0	13.3	15.1	15.8	14.5	19.7	16.0	13.9	13.8	15.2	15.3	13.4	1.81	1.55	1.47
Pyrene	11.5	14.4	16.6	17.8	15.0	16.4	18.6	16.1	18.7	15.0	13.2	16.4	16.1	21.9	20.3	1.49	1.32	1.14
Benzo(a)fluorene	9.62	7.25	7.19	15.5	13.7	19.8	16.1	22.1	11.4	11.0	9.97	9.05	14.8	10.1	9.91	0.00	0.00	0.00
1-methylpyrene	20.3	19.4	22.2	23.6	20.0	21.3	21.8	28.5	24.9	18.5	20.0	20.4	26.0	30.1	26.0	1.01	0.95	0.83
Benzo(a)anthracene	10.8	14.5	11.3	15.9	15.9	17.0	21.4	18.7	16.8	16.2	13.6	14.2	14.0	18.4	17.8	4.13	3.71	3.47
Chrysene	59.9	81.5	63.6	84.8	85.4	73.7	80.8	99.9	87.5	70.9	77.7	73.2	78.9	100	83.3	6.19	7.23	7.10
5-methylchrysene	29.6	39.5	24.7	48.9	51.9	51.9	57.1	44.8	50.4	38.0	41.5	39.4	39.9	50.8	37.2	0.00	0.00	0.00
Benzo(b)fluoranthene	10.8	12.7	7.31	13.2	11.9	15.1	12.0	13.6	14.6	10.2	7.94	11.5	11.9	16.3	8.59	2.36	1.91	1.75
Benzo(k)fluoranthene	4.51	4.41	5.45	7.65	5.96	7.20	5.75	5.87	4.91	5.88	4.85	5.76	5.14	4.73	5.57	3.07	2.54	2.10
Benzo(e)pyrene	21.2	15.0	13.5	30.1	25.1	25.6	24.2	27.4	28.9	22.3	21.2	22.8	25.3	21.0	20.5	6.45	5.41	4.74
Benzo(a)pyrene	8.03	5.77	6.49	10.3	8.51	9.98	8.21	9.11	9.64	5.76	4.49	5.96	8.98	6.95	7.73	6.95	4.07	7.76
Perylene	12.3	17.3	10.0	16.3	15.2	19.2	20.2	15.8	21.0	13.9	15.1	12.8	12.9	17.9	12.4	6.26	5.75	5.80
Indeno(1,2,3-cd)pyrene	0.85	0.00	0.00	0.00	0.00	0.00	0.00	1.35	0.00	0.00	0.94	0.00	1.03	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.35	4.37	3.01
Benzo(g,h,i)perylene	5.89	11.1	8.44	10.9	9.15	12.5	10.5	12.8	13.6	13.7	9.45	8.96	8.10	15.1	10.8	2.19	1.99	1.71
ΣPAH	389	428	366	545	499	553	550	588	559	443	433	428	502	546	474	55.3	49.6	47.9

Table A.13. Summary of raw results (µg/Kg, dry wt) for sediments - September 2011.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	2.97	4.68	4.51	6.63	5.57	5.81	6.34	6.21	6.78	5.39	3.48	4.45	3.95	5.21	4.59	1.31	2.11	1.34
Benzothiophene	1.40	0.00	0.00	0.00	0.00	0.00	0.00	2.38	0.00	0.00	1.34	0.00	1.61	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	4.17	2.97	3.13	4.63	3.89	4.61	4.46	5.15	3.30	4.06	4.46	3.18	5.30	3.07	4.07	0.72	1.34	0.79
Biphenyl	15.7	19.5	11.7	15.4	14.4	13.0	21.3	19.5	21.3	16.3	10.6	11.8	13.4	21.2	15.1	0.00	0.00	0.00
2-ethylnaphthalene	7.92	7.85	5.58	8.76	7.18	7.55	9.27	9.33	10.6	5.52	7.17	7.81	12.2	8.42	7.29	0.00	0.00	0.00
Acenaphthylene	2.13	0.00	0.00	0.00	0.00	0.00	0.00	2.98	0.00	0.00	2.20	0.00	2.36	0.00	0.00	0.00	0.00	0.00
Acenaphthene	5.28	5.69	5.32	7.38	5.74	6.02	6.86	6.85	6.57	6.96	6.26	4.78	4.52	8.11	7.44	0.00	0.00	0.00
Dibenzofuran	8.29	16.3	9.71	14.0	14.4	16.5	17.2	12.9	13.1	10.6	11.8	7.70	9.80	17.9	13.7	0.54	0.44	0.43
Fluorene	6.75	6.71	4.03	6.90	6.71	6.50	6.61	8.26	6.62	4.67	3.48	6.38	7.08	6.93	5.60	1.31	1.25	1.10
Dibenzothiophene	4.15	8.30	4.63	7.77	6.78	7.69	8.85	6.11	6.73	5.01	5.98	3.93	4.54	8.17	7.05	1.27	1.01	0.86
Phenanthrene	14.6	19.3	16.1	20.8	18.6	19.7	25.6	29.5	30.3	19.1	21.4	19.7	19.1	23.0	17.9	2.36	2.20	1.63
Anthracene	1.40	1.97	2.10	2.16	1.98	2.56	2.13	1.99	2.74	1.98	1.60	1.76	2.13	2.28	2.29	0.68	0.59	0.47
Carbozole	7.40	5.93	8.39	12.5	10.2	13.3	11.2	10.9	10.3	9.86	6.05	10.3	8.87	8.25	10.9	0.00	0.00	0.00
4-methyldibenzothiophene	12.3	8.78	8.28	18.9	17.4	25.6	19.0	28.2	13.1	14.0	11.5	11.4	17.4	10.9	11.7	0.00	0.00	0.00
2-methylphenanthrene	32.8	17.8	30.9	39.5	36.0	39.6	39.5	47.5	31.5	23.4	36.0	25.0	40.9	25.6	33.1	1.61	1.32	1.24
2-methylanthracene	17.6	12.2	17.5	19.5	17.5	17.6	22.9	23.8	21.4	16.0	13.1	18.7	20.2	18.7	19.7	0.00	0.00	0.00
1-methylphenanthrene	35.2	34.8	40.1	58.0	44.1	66.1	43.5	63.9	63.3	48.8	34.7	33.9	52.0	43.3	43.7	0.00	0.00	0.00
3,6-dimethylphenanthrene	25.9	37.6	25.8	51.2	42.6	48.9	45.2	40.1	47.8	35.1	38.7	38.2	34.4	47.6	33.4	1.75	1.40	1.27
Fluoranthene	16.3	14.8	14.7	18.5	15.4	19.1	20.0	16.9	23.4	18.5	18.0	16.8	18.4	19.2	14.5	2.23	1.97	1.84
Pyrene	13.9	18.0	21.3	22.0	19.2	21.0	22.8	19.3	21.9	17.4	15.5	21.1	20.0	27.1	22.7	2.08	1.76	1.53
Benzo(a)fluorene	11.9	8.78	8.75	19.3	16.9	25.7	20.1	27.3	13.9	12.8	12.4	11.6	16.9	11.0	11.1	0.00	0.00	0.00
1-methylpyrene	25.7	25.0	28.6	29.5	25.5	26.0	26.8	36.3	28.9	23.9	23.5	24.2	33.2	31.2	29.3	1.30	1.34	1.15
Benzo(a)anthracene	12.9	18.2	13.9	20.0	20.7	21.9	25.4	23.1	20.0	18.7	16.7	18.1	17.5	21.3	22.5	6.17	4.76	5.11
Chrysene	73.9	96.1	77.1	108	110	95.2	101	128	103	87.3	90.6	91.4	89.6	122	110	8.42	9.23	9.72
5-methylchrysene	35.9	49.6	29.1	58.6	64.6	64.8	69.1	51.8	61.8	48.8	47.7	46.3	44.2	59.6	41.0	0.00	0.00	0.00
Benzo(b)fluoranthene	13.6	14.8	8.87	15.5	15.0	18.3	13.8	17.5	17.8	12.0	9.2	14.6	14.2	19.8	10.4	2.89	2.65	2.11
Benzo(k)fluoranthene	5.60	5.44	6.59	9.91	7.50	8.64	7.13	7.01	5.68	7.11	5.86	7.04	6.71	5.76	7.14	4.29	3.57	2.62
Benzo(e)pyrene	26.3	17.9	17.1	36.2	29.6	32.5	30.7	33.6	35.5	28.9	25.9	29.5	27.6	24.2	24.6	8.68	6.44	5.44
Benzo(a)pyrene	10.0	7.01	8.28	11.8	10.5	11.6	10.0	11.0	11.8	6.95	5.49	7.02	10.5	9.18	8.41	9.23	5.32	10.9
Perylene	15.9	21.4	12.2	19.8	18.4	23.9	25.9	19.2	24.9	17.7	18.2	15.6	15.0	19.7	14.1	8.34	7.31	7.31
Indeno(1,2,3-cd)pyrene	0.98	0.00	0.00	0.00	0.00	0.00	0.00	1.58	0.00	0.00	1.10	0.00	1.37	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.07	4.93	3.99
Benzo(g,h,i)perylene	7.60	13.0	10.4	14.1	10.8	15.6	12.7	15.4	17.3	17.2	11.8	10.5	9.48	17.4	12.9	2.88	2.66	2.46
ΣPAH	476	520	455	677	617	685	675	734	682	544	522	523	585	646	566	73.1	63.6	63.3

Table A.14. Summary of raw results (µg/Kg, dry wt) for sediments - November 2011.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	2.52	4.12	3.98	5.97	4.47	4.67	5.33	5.24	5.53	4.42	3.09	3.87	3.18	3.98	3.61	1.35	1.86	1.04
Benzothiophene	1.18	0.00	0.00	0.00	0.00	0.00	0.00	1.94	0.00	0.00	1.15	0.00	1.29	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	3.37	2.51	2.67	3.76	3.48	3.91	3.64	4.47	2.68	3.31	3.78	2.80	4.18	2.48	3.23	0.61	1.13	0.68
Biphenyl	13.6	17.3	9.59	12.7	12.3	10.4	18.2	15.9	18.9	13.8	9.42	10.7	11.5	14.3	11.5	0.00	0.00	0.00
2-ethylnaphthalene	7.11	6.54	4.77	7.02	6.29	6.21	7.41	7.95	9.22	4.71	6.19	6.47	9.08	6.49	5.18	0.00	0.00	0.00
Acenaphthylene	1.77	0.00	0.00	0.00	0.00	0.00	0.00	2.60	0.00	0.00	1.80	0.00	1.81	0.00	0.00	0.00	0.00	0.00
Acenaphthene	4.32	4.95	4.37	6.27	4.86	5.12	6.13	6.00	5.83	6.19	5.07	4.15	3.55	6.30	6.12	0.00	0.00	0.00
Dibenzofuran	7.21	14.3	8.74	12.5	12.0	13.9	15.2	11.2	11.5	8.49	9.96	6.24	6.94	14.5	10.6	0.43	0.40	0.35
Fluorene	6.06	5.90	3.53	5.68	6.02	5.29	5.49	6.95	5.41	4.11	2.87	5.36	5.88	5.83	4.54	1.12	1.24	1.13
Dibenzothiophene	3.56	6.75	3.90	6.46	5.43	6.50	7.60	4.93	5.67	4.40	5.06	3.37	3.42	6.69	5.50	1.05	0.77	0.67
Phenanthrene	12.1	17.0	13.4	17.1	15.7	16.4	22.4	26.0	27.1	15.9	18.2	17.5	14.4	18.2	13.8	2.15	1.96	1.42
Anthracene	1.21	1.66	1.72	1.82	1.59	2.08	1.78	1.79	2.20	1.77	1.35	1.54	1.77	1.61	1.75	0.55	0.51	0.43
Carbozole	6.49	4.87	7.45	11.1	8.50	11.7	9.52	8.83	8.49	8.81	5.21	8.54	6.67	6.52	8.15	0.00	0.00	0.00
4-methyldibenzothiophene	10.5	7.78	6.70	16.7	15.0	21.3	15.3	22.9	11.4	12.0	9.42	9.65	15.5	9.39	8.59	0.00	0.00	0.00
2-methylphenanthrene	28.7	14.4	26.9	34.6	29.9	33.3	35.0	38.9	27.0	20.2	28.9	21.9	32.6	19.8	28.2	1.35	1.11	1.08
2-methylanthracene	15.5	10.0	14.4	16.8	15.2	14.4	18.9	19.2	17.2	13.5	11.3	15.3	16.0	14.6	15.6	0.00	0.00	0.00
1-methylphenanthrene	28.2	27.9	34.0	47.4	35.3	59.4	34.9	53.5	52.8	43.0	29.1	27.7	46.7	38.5	40.9	0.00	0.00	0.00
3,6-dimethylphenanthrene	21.6	33.6	21.8	43.8	37.6	42.3	40.7	33.9	39.4	29.6	31.3	33.0	28.3	36.0	28.3	1.48	1.18	1.07
Fluoranthene	13.1	12.0	12.0	15.5	12.7	16.7	16.1	15.0	20.1	15.4	15.3	13.9	13.6	14.5	12.2	1.72	1.57	1.38
Pyrene	12.0	14.6	17.6	18.6	17.1	18.3	18.6	17.1	19.5	14.9	13.1	17.2	15.1	21.7	18.5	1.57	1.52	1.38
Benzo(a)fluorene	10.1	7.57	7.31	15.7	14.0	21.3	16.9	23.4	12.1	11.3	10.1	9.36	13.9	9.52	9.53	0.00	0.00	0.00
1-methylpyrene	22.6	21.6	23.4	25.1	22.4	21.7	23.6	30.6	25.3	20.7	19.9	20.7	24.2	25.2	23.6	1.13	1.02	1.02
Benzo(a)anthracene	11.3	15.5	12.0	16.8	18.3	17.8	20.9	20.5	16.1	15.2	14.0	15.3	13.4	17.7	16.4	5.43	4.03	3.84
Chrysene	59.7	85.7	67.9	94.2	90.9	76.4	86.7	110	91.8	76.7	72.8	78.0	79.1	101	86.3	8.26	7.24	8.16
5-methylchrysene	30.4	40.8	23.8	47.6	55.0	56.2	61.9	45.2	49.6	39.6	40.6	39.8	40.4	46.0	33.1	0.00	0.00	0.00
Benzo(b)fluoranthene	11.2	13.3	7.39	13.6	13.1	16.4	11.6	14.9	15.3	9.96	8.00	12.2	11.9	16.0	8.41	2.92	2.25	1.82
Benzo(k)fluoranthene	4.98	4.80	5.92	8.73	6.71	7.27	5.83	6.14	4.62	6.10	5.16	5.76	5.29	4.75	5.27	3.82	3.01	2.24
Benzo(e)pyrene	22.3	14.3	14.1	31.7	24.1	26.8	26.5	29.2	28.9	23.9	20.8	25.1	22.6	18.7	19.5	6.40	6.62	4.95
Benzo(a)pyrene	8.23	5.91	7.00	10.6	8.44	10.1	8.61	9.76	9.44	5.88	4.39	5.77	8.75	7.41	6.83	9.08	4.33	7.54
Perylene	14.1	17.6	10.2	16.0	15.5	20.7	21.1	17.3	20.6	15.1	15.7	13.3	11.8	16.9	11.2	7.50	6.48	5.88
Indeno(1,2,3-cd)pyrene	0.86	0.00	0.00	0.00	0.00	0.00	0.00	1.38	0.00	0.00	0.89	0.00	1.08	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.27	4.59	3.60
Benzo(g,h,i)perylene	6.67	11.1	9.29	11.7	8.95	13.7	10.5	13.6	15.5	14.6	9.68	8.83	7.52	15.3	9.57	2.71	2.01	1.89
ΣPAH	402	445	386	575	521	580	576	626	579	464	433	443	481	521	456	64.9	54.8	51.6

Table A.15. Summary of raw results (µg/Kg, dry wt) for sediments - February 2012.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	2.24	3.64	3.72	5.69	4.17	4.42	4.77	4.90	4.76	4.22	2.86	3.61	2.75	3.81	3.18	1.20	1.66	1.23
Benzothiophene	1.15	0.00	0.00	0.00	0.00	0.00	0.00	1.79	0.00	0.00	1.01	0.00	1.30	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	2.98	2.29	2.29	3.16	3.31	3.85	3.28	4.02	2.43	3.16	3.55	2.60	3.77	2.19	3.18	0.65	1.17	0.79
Biphenyl	12.2	15.0	8.95	11.4	10.8	9.48	16.0	14.2	17.7	12.8	8.82	9.59	10.1	13.0	11.2	0.00	0.00	0.00
2-ethylnaphthalene	6.71	5.88	4.57	6.49	6.05	5.79	6.89	7.52	8.93	4.40	5.88	6.14	8.70	6.37	4.75	0.00	0.00	0.00
Acenaphthylene	1.51	0.00	0.00	0.00	0.00	0.00	0.00	2.37	0.00	0.00	1.56	0.00	1.76	0.00	0.00	0.00	0.00	0.00
Acenaphthene	3.73	4.55	3.71	5.61	4.32	4.45	5.25	5.37	5.42	5.42	4.58	3.77	3.27	5.78	4.98	0.00	0.00	0.00
Dibenzofuran	6.41	12.6	8.35	11.8	10.8	13.2	13.6	10.5	10.7	7.79	8.58	5.60	7.04	13.3	9.45	0.45	0.35	0.42
Fluorene	5.23	5.57	3.42	5.11	5.67	4.62	4.86	6.55	4.64	3.72	2.55	4.77	5.19	5.21	3.87	1.18	1.21	1.15
Dibenzothiophene	3.09	6.22	3.49	5.99	4.84	5.75	7.39	4.12	4.84	3.85	4.77	3.00	3.09	6.66	4.60	1.17	0.77	0.69
Phenanthrene	11.0	14.3	12.6	15.1	14.2	15.9	20.3	24.8	23.7	14.5	16.2	16.3	14.5	16.3	12.5	2.54	1.84	1.64
Anthracene	1.13	1.54	1.60	1.74	1.37	1.84	1.67	1.55	2.09	1.66	1.18	1.38	1.51	1.46	1.58	0.61	0.55	0.48
Carbozole	5.64	4.25	6.32	10.3	7.74	10.8	8.95	7.55	7.61	7.91	4.81	7.59	5.82	5.44	7.27	0.00	0.00	0.00
4-methyldibenzothiophene	9.15	7.08	5.90	15.6	13.9	19.1	13.5	21.1	10.5	11.0	8.44	8.67	13.3	8.96	7.88	0.00	0.00	0.00
2-methylphenanthrene	27.2	13.6	24.1	32.3	29.2	30.1	29.6	34.7	23.7	18.7	27.4	19.8	27.9	20.6	23.0	1.29	1.18	1.14
2-methylanthracene	14.1	9.79	13.4	15.9	13.9	12.8	16.6	16.6	16.0	13.1	10.6	14.2	15.0	12.9	15.7	0.00	0.00	0.00
1-methylphenanthrene	27.2	24.9	31.7	43.6	33.6	54.6	30.5	51.9	47.7	36.9	27.6	25.4	44.0	31.6	37.5	0.00	0.00	0.00
3,6-dimethylphenanthrene	19.0	29.4	19.2	39.6	36.2	40.2	39.4	30.4	36.5	25.2	26.6	29.4	24.6	33.1	25.5	1.83	1.17	1.22
Fluoranthene	12.1	10.9	10.5	13.9	11.5	14.8	15.0	12.6	17.9	13.4	14.7	12.2	11.5	14.0	11.5	2.00	1.79	1.57
Pyrene	11.4	13.4	15.2	16.6	15.7	16.4	16.9	15.5	17.5	13.4	12.0	15.7	14.5	21.9	18.3	1.78	1.70	1.41
Benzo(a)fluorene	9.26	7.00	6.69	14.5	13.3	19.0	15.4	22.1	10.3	10.6	9.66	8.16	12.8	10.0	8.79	0.00	0.00	0.00
1-methylpyrene	20.2	20.1	20.4	22.8	20.7	18.7	22.0	29.3	23.0	18.4	17.2	19.2	24.1	21.3	23.8	1.13	1.06	0.98
Benzo(a)anthracene	9.95	13.7	10.3	15.3	17.5	15.7	20.2	18.1	14.3	14.8	11.9	13.3	12.0	17.2	14.1	5.49	3.76	4.57
Chrysene	50.7	74.8	62.0	83.4	84.0	67.6	81.5	97.4	76.3	71.4	62.7	67.2	70.1	91.3	74.2	7.30	9.38	9.34
5-methylchrysene	27.8	37.8	22.4	44.8	48.8	50.8	54.3	43.7	46.0	36.4	39.1	35.0	35.4	41.2	30.0	0.00	0.00	0.00
Benzo(b)fluoranthene	10.6	11.7	6.85	12.7	11.6	14.8	10.4	13.3	13.7	8.96	7.08	10.8	11.1	14.6	7.68	2.68	2.28	1.97
Benzo(k)fluoranthene	4.73	4.18	5.61	8.08	6.04	6.51	5.37	5.38	4.25	5.50	4.30	5.00	4.82	3.89	4.82	3.60	3.45	2.57
Benzo(e)pyrene	20.6	12.6	12.0	29.0	21.5	24.9	24.6	27.1	25.9	21.9	18.6	22.6	21.2	15.7	17.2	7.12	7.22	5.27
Benzo(a)pyrene	7.13	5.65	6.56	8.88	7.61	8.53	7.56	8.32	8.21	5.69	3.84	5.24	8.03	6.86	6.53	8.21	4.33	8.86
Perylene	13.2	16.6	8.83	13.7	13.7	18.7	20.5	15.8	20.3	13.5	14.6	12.8	10.6	14.4	9.90	8.08	7.07	7.21
Indeno(1,2,3-cd)pyrene	0.77	0.00	0.00	0.00	0.00	0.00	0.00	1.17	0.00	0.00	0.74	0.00	1.07	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.71	4.56	3.73
Benzo(g,h,i)perylene	6.08	10.6	8.18	11.1	8.06	12.9	9.97	12.7	14.2	13.9	8.78	8.26	7.03	13.0	9.30	2.70	2.12	2.04
ΣPAH	364	400	349	524	480	526	526	572	519	422	392	397	438	472	412	65.7	58.6	58.3

Table A.16. Summary of raw results (µg/Kg, dry wt) for sediments - May 2012.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	1.75	3.19	3.13	4.23	3.14	3.41	3.96	4.02	4.07	3.53	2.48	2.96	2.38	3.04	2.65	1.35	1.87	1.19
Benzothiophene	0.91	0.00	0.00	0.00	0.00	0.00	0.00	1.46	0.00	0.00	0.88	0.00	1.09	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	2.56	1.89	1.88	2.67	2.31	2.89	2.71	3.46	2.03	2.45	2.74	2.01	3.12	1.88	2.62	0.76	1.13	0.78
Biphenyl	10.8	12.5	7.39	8.99	8.95	7.33	13.8	12.7	14.1	10.2	7.41	8.13	8.35	11.0	8.65	0.00	0.00	0.00
2-ethylnaphthalene	5.34	4.93	3.57	4.91	4.48	4.23	5.58	6.03	7.13	3.69	4.62	4.88	7.12	4.79	3.80	0.00	0.00	0.00
Acenaphthylene	1.23	0.00	0.00	0.00	0.00	0.00	0.00	1.94	0.00	0.00	1.35	0.00	1.44	0.00	0.00	0.00	0.00	0.00
Acenaphthene	3.24	3.77	3.12	4.11	3.57	3.57	4.30	4.24	4.40	4.57	3.58	3.11	2.94	4.95	4.57	0.00	0.00	0.00
Dibenzofuran	5.24	10.7	6.71	8.25	8.48	9.72	11.6	8.58	8.87	6.33	7.49	4.54	6.02	10.9	8.11	0.44	0.35	0.40
Fluorene	4.30	4.59	2.71	3.95	4.44	3.42	4.02	5.30	3.91	3.05	2.09	4.01	4.49	4.28	3.40	1.39	1.29	0.99
Dibenzothiophene	2.64	5.11	2.93	4.57	3.89	4.40	5.67	3.43	4.04	3.31	4.03	2.51	2.68	5.48	4.19	0.93	0.87	0.63
Phenanthrene	9.10	11.8	10.5	11.7	11.5	11.5	16.6	20.0	19.8	11.6	13.8	12.6	12.4	14.9	9.99	2.62	1.88	1.49
Anthracene	0.93	1.27	1.25	1.33	1.12	1.43	1.33	1.32	1.74	1.27	0.97	1.13	1.35	1.26	1.29	0.56	0.61	0.42
Carbozole	4.80	3.47	5.28	7.50	6.00	7.91	7.59	6.42	6.35	6.70	3.70	6.18	5.10	5.06	6.23	0.00	0.00	0.00
4-methyldibenzothiophene	7.86	5.68	5.08	12.0	10.5	14.6	11.3	16.3	8.48	8.79	7.35	7.40	11.1	7.44	6.70	0.00	0.00	0.00
2-methylphenanthrene	21.4	10.9	20.8	24.2	20.1	23.4	25.0	28.4	19.7	15.1	21.3	15.5	24.8	16.2	21.2	1.43	1.07	1.16
2-methylanthracene	11.5	7.78	10.8	11.7	9.87	10.4	14.2	14.2	13.4	10.7	8.13	11.5	11.3	11.5	13.2	0.00	0.00	0.00
1-methylphenanthrene	22.3	21.8	24.7	32.4	24.4	41.9	24.2	39.4	39.7	30.7	22.6	20.6	35.5	27.4	30.3	0.00	0.00	0.00
3,6-dimethylphenanthrene	15.8	23.9	16.6	30.0	26.6	29.5	30.5	24.8	30.3	21.5	22.6	23.8	21.3	27.5	19.6	1.57	1.12	1.12
Fluoranthene	10.1	8.72	8.75	10.1	9.12	11.6	12.0	11.0	14.7	11.1	11.4	10.3	10.7	11.0	9.56	1.91	1.47	1.67
Pyrene	9.30	11.2	12.8	12.8	12.4	12.6	14.3	12.6	15.3	11.5	9.56	12.4	11.7	18.9	14.1	1.67	1.89	1.33
Benzo(a)fluorene	7.45	5.76	5.59	10.6	10.5	14.8	12.9	18.4	9.05	8.25	7.57	6.84	10.4	7.46	6.80	0.00	0.00	0.00
1-methylpyrene	16.6	16.5	17.3	16.4	15.0	14.7	17.4	24.3	18.4	15.4	15.2	15.3	19.3	19.1	19.4	1.28	0.89	1.12
Benzo(a)anthracene	8.57	11.2	8.32	10.8	13.0	12.4	15.9	15.5	12.2	11.9	10.3	11.9	10.1	12.5	13.0	4.96	4.13	4.55
Chrysene	44.5	65.1	50.0	62.9	64.5	52.0	64.7	80.9	67.7	57.3	52.3	57.9	60.0	74.5	60.6	8.62	8.34	8.51
5-methylchrysene	21.8	29.2	18.4	35.3	37.9	38.7	45.1	34.9	37.4	30.0	29.8	28.6	29.0	34.1	24.6	0.00	0.00	0.00
Benzo(b)fluoranthene	8.29	10.2	5.56	9.55	8.79	11.4	8.48	11.0	11.1	7.06	5.82	8.77	9.36	11.6	6.41	2.59	2.30	1.99
Benzo(k)fluoranthene	3.93	3.49	4.57	6.53	4.66	5.07	4.40	4.63	3.41	4.46	3.60	4.16	4.08	3.38	4.03	3.20	3.07	2.23
Benzo(e)pyrene	16.5	11.2	10.4	22.0	17.5	18.0	20.0	22.4	22.5	16.8	15.9	17.9	17.4	14.2	13.3	7.48	6.93	4.99
Benzo(a)pyrene	5.87	4.45	5.42	6.70	6.24	6.70	6.14	7.12	7.10	4.48	3.19	4.31	6.49	6.07	5.56	8.30	4.38	7.45
Perylene	11.1	12.6	7.8	11.0	10.6	14.0	16.4	13.2	15.7	11.2	12.4	10.2	9.26	12.8	8.09	7.68	6.05	6.59
Indeno(1,2,3-cd)pyrene	0.65	0.00	0.00	0.00	0.00	0.00	0.00	1.01	0.00	0.00	0.64	0.00	0.81	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.12	4.75	3.05
Benzo(g,h,i)perylene	5.27	8.74	7.00	8.13	5.96	9.98	8.08	10.6	11.4	10.9	6.94	6.80	5.74	11.3	7.49	3.12	2.45	2.24
ΣPAH	302	332	288	395	366	401	428	470	434	344	322	326	367	395	339	67.0	56.9	53.9

Table A.17. Summary of raw results (µg/Kg, dry wt) for sediments - August 2012.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	1.42	2.62	2.48	3.69	2.74	3.02	3.16	3.19	3.39	2.77	2.03	2.42	1.83	2.41	2.09	1.49	2.17	1.33
Benzothiophene	0.76	0.00	0.00	0.00	0.00	0.00	0.00	1.14	0.00	0.00	0.73	0.00	0.81	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	2.12	1.50	1.51	2.24	2.12	2.58	2.17	2.88	1.62	1.99	2.14	1.64	2.46	1.40	1.97	0.84	1.37	0.71
Biphenyl	8.54	9.83	5.78	7.70	7.82	6.51	11.0	10.3	11.2	8.00	6.19	6.48	6.17	8.75	6.67	0.00	0.00	0.00
2-ethylnaphthalene	4.22	3.96	2.82	4.40	3.83	3.68	4.54	4.99	5.89	3.08	3.78	4.10	5.40	3.64	2.94	0.00	0.00	0.00
Acenaphthylene	0.97	0.00	0.00	0.00	0.00	0.00	0.00	1.53	0.00	0.00	1.07	0.00	1.13	0.00	0.00	0.00	0.00	0.00
Acenaphthene	2.63	2.99	2.53	3.68	3.16	3.05	3.59	3.54	3.45	3.63	2.98	2.47	2.02	3.70	3.40	0.00	0.00	0.00
Dibenzofuran	4.19	8.56	5.59	7.52	7.44	8.60	9.20	6.83	7.07	5.21	5.98	3.68	4.72	7.96	5.97	0.50	0.47	0.44
Fluorene	3.59	3.59	2.13	3.49	3.77	2.98	3.36	4.24	3.25	2.55	1.64	3.33	3.50	3.43	2.40	1.45	1.52	1.22
Dibenzothiophene	2.14	4.07	2.38	4.08	3.45	3.82	4.50	2.74	3.35	2.65	3.30	2.06	2.12	3.96	3.09	1.18	1.04	0.74
Phenanthrene	7.63	9.31	8.55	10.1	10.1	9.67	13.0	16.4	15.5	9.56	10.9	10.0	9.32	11.5	7.65	2.88	2.07	1.62
Anthracene	0.74	1.03	1.03	1.19	0.94	1.23	1.10	1.06	1.42	1.03	0.77	0.89	1.00	0.95	0.97	0.71	0.49	0.51
Carbozole	3.82	2.80	4.22	6.65	5.26	7.03	6.26	5.16	5.29	5.27	2.93	4.88	3.68	3.74	4.69	0.00	0.00	0.00
4-methyldibenzothiophene	6.43	4.52	4.06	10.2	9.23	12.6	9.12	12.9	6.87	7.08	6.05	5.80	8.18	6.04	5.22	0.00	0.00	0.00
2-methylphenanthrene	17.6	8.79	17.5	21.8	17.8	20.7	19.8	23.0	15.5	12.6	17.4	12.5	19.0	12.8	16.5	1.70	1.19	1.20
2-methylanthracene	9.41	6.21	8.81	10.3	8.73	8.82	11.8	11.5	11.1	8.68	6.52	9.07	8.69	9.19	9.86	0.00	0.00	0.00
1-methylphenanthrene	17.4	17.7	19.8	27.9	21.5	38.0	19.7	31.5	32.9	25.1	18.7	16.9	26.5	20.8	24.3	0.00	0.00	0.00
3,6-dimethylphenanthrene	13.0	19.9	13.6	25.4	23.9	24.9	24.0	20.5	23.9	17.2	18.2	19.2	15.4	21.9	15.7	2.08	1.41	1.40
Fluoranthene	8.24	6.88	6.86	8.68	8.27	10.1	9.52	8.84	11.7	9.30	9.59	8.43	7.53	8.02	7.15	1.95	2.01	1.65
Pyrene	7.66	9.23	10.3	11.3	10.4	11.4	11.5	10.5	12.6	9.26	7.80	9.77	8.71	15.0	10.9	1.87	1.74	1.38
Benzo(a)fluorene	6.21	4.74	4.55	9.54	8.70	12.4	10.3	14.5	7.12	6.62	6.31	5.38	7.69	5.74	5.17	0.00	0.00	0.00
1-methylpyrene	13.9	13.3	14.1	14.7	13.0	12.7	13.7	19.5	14.6	12.4	12.5	12.4	15.0	13.7	14.5	1.37	1.14	1.13
Benzo(a)anthracene	6.95	8.93	6.92	9.93	11.1	10.4	12.9	12.7	9.91	9.28	8.63	9.85	8.18	9.70	9.59	5.68	4.24	5.02
Chrysene	36.2	52.8	39.5	56.7	55.3	44.6	52.8	67.5	55.4	47.7	42.1	48.3	45.8	59.2	46.2	8.38	8.58	8.72
5-methylchrysene	17.6	22.9	15.3	29.5	32.3	33.5	37.4	27.8	31.2	23.8	23.4	23.5	22.1	26.5	18.0	0.00	0.00	0.00
Benzo(b)fluoranthene	6.49	8.40	4.43	7.92	7.93	10.2	7.06	8.72	9.01	5.51	4.62	7.01	6.70	8.87	4.95	3.41	2.96	2.02
Benzo(k)fluoranthene	3.12	2.75	3.77	5.80	4.08	4.42	3.47	3.64	2.73	3.68	3.00	3.33	3.17	2.46	2.97	4.56	3.64	2.97
Benzo(e)pyrene	13.8	9.01	8.48	19.0	15.2	15.6	15.8	18.7	17.8	14.0	12.7	14.5	13.4	11.4	10.7	8.75	8.46	5.22
Benzo(a)pyrene	4.75	3.54	4.55	6.18	5.45	6.01	5.07	5.61	5.84	3.76	2.62	3.52	4.86	4.34	4.43	9.73	4.54	9.62
Perylene	8.66	9.85	6.41	9.47	9.59	12.2	13.7	10.7	12.5	9.40	10.3	8.15	6.44	9.87	6.68	8.77	8.11	7.09
Indeno(1,2,3-cd)pyrene	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.53	0.00	0.62	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.06	6.29	3.92
Benzo(g,h,i)perylene	4.22	7.21	5.69	6.92	5.45	8.32	6.65	8.83	9.53	8.91	5.73	5.71	4.21	8.46	5.72	3.37	2.29	2.43
ΣPAH	245	267	234	346	319	349	346	382	352	280	261	265	276	305	260	75.7	65.7	60.3

Table A.18. Summary of raw results (µg/Kg, dry wt) for sediments - September 2012.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	1.71	3.18	3.09	4.54	3.31	3.69	3.92	3.90	4.24	3.35	2.53	2.96	2.19	3.31	2.93	1.41	2.03	1.24
Benzothiophene	0.90	0.00	0.00	0.00	0.00	0.00	0.00	1.34	0.00	0.00	0.89	0.00	1.07	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	2.57	1.78	1.82	2.79	2.63	3.02	2.63	3.37	2.02	2.38	2.60	1.91	3.67	2.10	2.81	0.78	1.38	0.71
Biphenyl	10.5	12.0	6.82	9.01	9.27	7.81	13.4	12.0	13.9	9.62	7.49	7.73	8.23	12.0	9.14	0.00	0.00	0.00
2-ethylnaphthalene	5.11	4.86	3.41	5.12	4.56	4.56	5.48	5.92	7.22	3.73	4.40	5.03	7.22	5.16	3.92	0.00	0.00	0.00
Acenaphthylene	1.16	0.00	0.00	0.00	0.00	0.00	0.00	1.88	0.00	0.00	1.28	0.00	1.59	0.00	0.00	0.00	0.00	0.00
Acenaphthene	3.08	3.48	3.07	4.37	3.83	3.64	4.25	4.26	4.21	4.26	3.48	3.06	2.85	4.51	4.81	0.00	0.00	0.00
Dibenzofuran	5.12	10.5	6.59	8.92	8.76	10.5	10.9	8.15	8.60	6.32	7.44	4.48	5.80	11.3	7.95	0.49	0.45	0.43
Fluorene	4.26	4.38	2.64	4.14	4.39	3.66	3.95	5.12	3.82	3.16	1.97	4.16	4.86	4.75	3.19	1.51	1.44	1.29
Dibenzothiophene	2.51	5.06	2.79	4.95	4.27	4.66	5.27	3.22	4.03	3.28	4.07	2.40	2.80	5.47	4.02	1.13	0.89	0.71
Phenanthrene	9.37	11.5	10.4	12.5	12.0	11.9	15.4	19.5	19.2	11.9	13.3	11.7	13.7	14.7	10.8	2.56	2.07	1.64
Anthracene	0.90	1.23	1.22	1.41	1.10	1.47	1.37	1.31	1.68	1.23	0.95	1.06	1.41	1.32	1.32	0.71	0.52	0.52
Carbozole	4.75	3.47	5.11	7.96	6.45	8.67	7.74	6.23	6.53	6.26	3.54	5.91	5.02	5.07	6.88	0.00	0.00	0.00
4-methyldibenzothiophene	7.63	5.51	4.92	12.2	11.4	15.1	11.3	15.6	8.13	8.61	7.32	7.07	11.4	7.65	7.16	0.00	0.00	0.00
2-methylphenanthrene	21.4	10.9	20.8	26.7	21.4	24.5	23.9	27.9	18.2	14.9	20.3	15.2	26.0	16.2	23.4	1.51	1.13	1.19
2-methylanthracene	11.7	7.33	10.8	12.2	10.2	10.3	14.1	13.6	13.1	10.1	8.08	11.0	12.7	11.7	12.4	0.00	0.00	0.00
1-methylphenanthrene	20.2	21.1	23.3	33.4	25.4	46.5	24.6	38.6	39.2	30.0	23.0	20.8	35.5	29.7	33.0	0.00	0.00	0.00
3,6-dimethylphenanthrene	15.4	23.8	16.3	30.9	27.8	29.7	29.8	25.4	28.7	20.3	22.2	23.9	20.1	30.4	21.1	1.80	1.46	1.27
Fluoranthene	10.0	8.09	8.25	10.6	10.3	11.8	11.7	10.9	14.3	11.4	11.2	10.3	9.43	11.7	9.21	1.96	1.70	1.54
Pyrene	9.37	11.5	12.1	14.1	12.1	13.9	14.3	13.0	15.1	11.1	9.50	11.7	12.8	19.8	14.3	1.78	1.86	1.30
Benzo(a)fluorene	7.70	5.88	5.38	11.5	10.8	15.2	12.9	16.9	8.70	7.69	7.88	6.28	10.6	7.87	7.10	0.00	0.00	0.00
1-methylpyrene	16.3	16.4	17.6	17.5	16.3	15.6	16.4	22.8	17.6	15.3	15.2	15.4	20.1	19.8	19.1	1.25	1.16	1.13
Benzo(a)anthracene	8.66	11.1	8.44	11.9	13.3	12.3	15.5	14.9	12.2	11.3	10.5	12.1	12.1	12.8	13.2	5.21	4.37	4.81
Chrysene	44.1	64.7	48.3	68.5	67.4	53.3	61.4	78.9	68.2	55.4	52.0	60.4	57.7	86.1	60.8	8.46	8.81	8.53
5-methylchrysene	20.5	26.6	19.1	35.2	38.7	40.0	44.8	33.7	36.3	28.8	27.8	28.3	29.8	39.4	24.1	0.00	0.00	0.00
Benzo(b)fluoranthene	8.11	10.5	5.31	9.59	9.51	11.9	8.31	10.9	10.5	6.56	5.72	8.50	10.8	12.3	6.85	3.49	2.94	2.05
Benzo(k)fluoranthene	3.89	3.38	4.49	6.95	4.82	5.47	4.20	4.49	3.34	4.42	3.64	3.89	4.45	3.62	4.41	4.31	3.42	2.79
Benzo(e)pyrene	16.8	10.9	10.3	22.4	17.9	18.3	19.2	22.1	22.1	17.2	15.3	18.0	18.0	15.8	15.1	7.93	7.85	4.80
Benzo(a)pyrene	5.81	4.16	5.32	7.62	6.59	7.29	6.32	7.00	7.15	4.57	3.23	4.28	6.90	5.70	5.79	9.13	5.10	8.68
Perylene	10.4	11.6	7.59	11.5	11.6	15.1	16.5	12.9	15.4	11.1	12.8	10.0	9.10	14.3	9.09	8.54	7.47	6.44
Indeno(1,2,3-cd)pyrene	0.62	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.65	0.00	0.82	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.18	6.01	3.66
Benzo(g,h,i)perylene	5.07	8.82	6.74	8.54	6.43	10.3	8.00	10.3	11.5	10.7	6.67	7.09	5.97	12.4	8.25	3.15	2.36	2.18
ΣPAH	296	324	282	417	383	420	418	457	425	335	317	325	375	427	352	72.3	64.4	56.9

Table A.19. Summary of raw results (µg/Kg, dry wt) for diploid oysters - July 2011.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	0.46	0.68	0.69	0.81	0.74	0.97	0.82	1.02	0.76	0.66	0.52	0.74	0.71	0.95	0.70	0.71	0.90	0.62
Benzothiophene	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.22	0.00	0.29	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	0.64	0.50	0.38	0.72	0.57	0.51	0.56	0.69	0.41	0.50	0.69	0.53	0.70	0.39	0.70	0.34	0.49	0.36
Biphenyl	2.47	2.57	1.50	2.53	2.46	2.25	3.18	3.06	3.04	2.35	1.38	1.52	2.20	3.12	2.55	0.00	0.00	0.00
2-ethylnaphthalene	1.39	0.97	0.70	1.07	1.07	1.20	1.08	1.14	1.83	1.06	1.16	1.05	1.63	1.31	1.11	0.00	0.00	0.00
Acenaphthylene	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.00	0.00	0.37	0.00	0.33	0.00	0.00	0.00	0.00	0.00
Acenaphthene	0.89	0.90	0.84	1.29	0.81	0.86	1.16	1.03	1.02	0.96	0.88	0.81	0.80	1.34	1.11	0.00	0.00	0.00
Dibenzofuran	1.20	2.11	1.41	2.46	1.66	2.11	3.25	1.93	2.02	1.90	2.23	1.02	1.33	2.74	2.17	0.26	0.23	0.18
Fluorene	0.94	0.81	0.61	1.06	0.79	0.98	0.77	1.26	1.18	0.82	0.63	1.13	1.29	1.09	0.82	0.63	0.55	0.61
Dibenzothiophene	0.64	1.06	0.58	1.40	0.90	1.32	1.47	0.87	0.93	0.89	0.78	0.48	0.63	1.45	1.11	0.50	0.41	0.44
Phenanthrene	2.27	3.23	2.52	2.95	2.49	2.79	2.89	3.55	4.16	3.09	3.61	3.04	3.03	3.15	2.00	0.96	1.18	0.75
Anthracene	0.44	0.62	0.59	0.58	0.48	0.82	0.66	0.59	0.83	0.61	0.48	0.40	0.71	0.72	0.73	0.30	0.28	0.20
Carbozole	1.09	0.76	1.07	1.55	1.71	1.89	1.78	1.54	1.02	1.43	0.80	1.10	1.52	1.09	1.46	0.00	0.00	0.00
4-methyldibenzothiophene	1.84	1.08	1.14	2.26	2.09	2.72	2.35	3.67	1.87	2.10	1.79	1.26	2.18	1.91	1.49	0.00	0.00	0.00
2-methylphenanthrene	4.42	2.21	4.37	6.33	4.23	6.28	6.37	5.15	4.42	3.72	4.75	3.37	5.73	3.29	5.04	0.79	0.55	0.61
2-methylanthracene	2.08	1.81	2.20	2.57	2.33	2.41	2.90	3.12	3.49	2.75	2.22	2.32	2.25	2.14	3.29	0.00	0.00	0.00
1-methylphenanthrene	5.07	5.05	4.99	6.95	6.14	10.0	6.47	9.1	9.10	5.44	4.61	6.07	7.13	6.93	6.24	0.00	0.00	0.00
3,6-dimethylphenanthrene	4.20	5.02	3.22	6.15	6.68	7.68	6.86	4.62	5.58	4.20	4.85	5.09	4.04	6.88	5.12	0.75	0.56	0.60
Fluoranthene	2.83	1.89	1.60	2.41	1.98	2.96	2.66	2.09	3.53	2.55	2.96	2.42	2.33	2.07	2.37	1.03	0.91	0.82
Pyrene	1.72	2.61	3.08	3.25	3.05	2.30	3.44	3.36	3.48	2.16	1.80	3.16	3.09	3.83	2.83	0.93	0.81	0.73
Benzo(a)fluorene	1.41	0.97	1.20	2.45	2.46	3.72	2.64	3.35	2.29	1.55	1.54	1.73	2.09	1.35	1.93	0.00	0.00	0.00
1-methylpyrene	3.95	3.62	4.19	3.20	3.53	4.22	3.00	4.02	4.59	2.83	3.67	3.45	3.78	4.68	3.76	0.61	0.60	0.52
Benzo(a)anthracene	1.66	2.17	2.05	2.52	3.08	2.86	4.01	3.36	3.48	2.71	2.59	2.71	2.73	2.93	2.60	2.69	2.22	2.24
Chrysene	9.07	13.1	12.5	14.6	16.5	14.1	13.0	17.9	16.6	10.2	11.5	12.5	14.5	17.9	13.9	3.45	4.39	4.14
5-methylchrysene	4.83	6.67	4.56	9.9	8.93	10.8	11.4	8.71	10.0	7.57	6.89	6.83	6.20	10.0	5.38	0.00	0.00	0.00
Benzo(b)fluoranthene	1.47	2.43	1.43	1.93	2.32	3.01	2.13	2.62	2.67	1.40	1.32	1.91	2.23	2.48	1.53	1.24	1.17	1.13
Benzo(k)fluoranthene	0.65	0.83	0.99	1.34	1.04	1.18	0.98	1.05	0.78	0.97	0.95	1.11	1.03	0.82	1.03	1.95	1.53	1.23
Benzo(e)pyrene	3.65	2.05	2.54	5.86	3.89	3.71	3.88	4.86	5.57	3.52	3.09	3.53	3.89	3.23	3.28	3.91	3.04	2.98
Benzo(a)pyrene	1.48	0.83	1.10	1.83	1.45	1.65	1.49	1.69	1.65	0.80	0.81	1.11	1.42	1.37	1.67	4.53	2.28	4.71
Perylene	2.31	3.28	1.60	2.95	2.38	3.53	3.49	2.78	2.90	1.82	2.96	2.39	1.84	3.36	2.23	4.17	3.26	2.89
Indeno(1,2,3-cd)pyrene	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.17	0.00	0.19	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.62	2.33	1.93
Benzo(g,h,i)perylene	1.09	2.05	1.37	2.07	1.58	1.65	2.03	1.87	2.84	2.21	1.70	1.57	1.10	3.01	1.78	1.48	1.15	1.08
ΣPAH	66.9	71.9	65.0	95	87.4	100	97	101	102	72.8	74.0	74.4	82.9	96	79.9	33.9	28.9	28.8

Table A.20. Summary of raw results (µg/Kg, dry wt) for diploid oysters - September 2011.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	0.57	0.82	0.87	0.89	0.85	0.88	1.05	0.91	1.06	0.90	0.60	0.60	0.62	1.01	0.78	0.74	1.12	0.56
Benzothiophene	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.24	0.00	0.26	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	0.72	0.53	0.53	0.74	0.53	0.65	0.59	0.64	0.46	0.53	0.70	0.57	0.86	0.46	0.69	0.39	0.63	0.36
Biphenyl	3.05	3.00	1.78	1.75	1.83	2.11	3.17	2.81	3.17	2.34	1.75	1.59	2.26	3.77	2.54	0.00	0.00	0.00
2-ethylnaphthalene	1.20	1.56	1.04	1.42	1.19	1.26	1.49	1.49	1.62	1.04	0.99	1.13	1.69	1.39	1.34	0.00	0.00	0.00
Acenaphthylene	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.34	0.00	0.34	0.00	0.00	0.00	0.00	0.00
Acenaphthene	0.99	0.83	0.78	1.07	0.98	0.93	1.03	1.01	1.09	1.32	0.93	0.85	0.60	1.45	1.43	0.00	0.00	0.00
Dibenzofuran	1.61	2.90	1.57	1.97	2.49	2.80	2.64	1.48	1.48	2.06	1.67	1.38	1.70	2.69	2.40	0.27	0.22	0.21
Fluorene	1.32	1.10	0.81	0.89	0.80	0.86	0.77	1.35	0.91	0.80	0.52	0.92	1.20	1.24	0.95	0.71	0.59	0.59
Dibenzothiophene	0.85	1.42	0.93	1.23	1.21	1.10	1.42	0.77	0.77	0.76	0.81	0.58	0.80	1.25	1.07	0.59	0.51	0.41
Phenanthrene	2.16	3.43	3.45	2.79	2.86	3.21	3.47	4.84	4.85	3.15	4.25	3.25	3.51	3.77	2.65	1.34	1.00	0.89
Anthracene	0.53	0.72	0.78	0.76	0.59	0.69	0.59	0.63	0.70	0.59	0.49	0.67	0.73	0.65	0.68	0.40	0.28	0.21
Carbozole	1.46	1.18	1.76	1.78	1.60	2.00	1.51	1.79	1.71	1.29	0.97	1.89	1.17	1.34	1.53	0.00	0.00	0.00
4-methyldibenzothiophene	1.85	1.36	1.62	2.26	2.63	3.65	2.91	4.52	1.54	2.50	2.09	2.25	3.40	1.64	1.83	0.00	0.00	0.00
2-methylphenanthrene	6.03	3.32	4.43	5.34	5.89	6.38	5.87	8.23	4.86	4.37	6.36	3.29	5.66	3.96	5.04	0.74	0.64	0.60
2-methylanthracene	3.79	1.79	2.52	2.56	2.43	2.85	3.88	2.90	3.05	2.75	2.22	2.44	3.34	2.40	2.77	0.00	0.00	0.00
1-methylphenanthrene	7.14	6.50	5.42	9.8	7.11	8.67	5.84	8.94	8.06	8.35	4.35	6.41	8.47	8.47	7.19	0.00	0.00	0.00
3,6-dimethylphenanthrene	5.45	7.29	5.67	8.9	6.06	6.79	7.04	5.25	7.39	6.49	5.26	6.55	5.89	7.29	4.62	0.94	0.73	0.66
Fluoranthene	2.85	2.24	2.36	2.17	2.24	3.21	3.31	2.85	3.89	3.08	3.47	2.30	3.70	2.65	2.28	1.15	1.06	0.97
Pyrene	2.27	2.94	3.09	3.44	2.49	3.00	2.74	3.15	2.58	3.42	2.89	3.20	3.49	4.37	3.42	0.97	0.88	0.74
Benzo(a)fluorene	1.79	1.52	1.61	2.51	2.19	3.55	2.40	3.75	2.05	1.72	2.19	1.97	2.61	1.75	1.86	0.00	0.00	0.00
1-methylpyrene	4.50	3.85	5.82	4.76	4.12	3.81	3.28	4.68	5.05	4.10	3.33	4.49	5.30	5.55	3.85	0.59	0.63	0.58
Benzo(a)anthracene	2.61	3.98	2.35	2.43	3.10	3.20	3.68	3.27	2.56	3.20	2.82	2.57	3.12	3.51	3.44	2.89	2.56	2.21
Chrysene	13.4	15.8	16.4	14.5	13.4	12.4	14.3	15.6	13.0	15.6	17.4	14.7	14.2	18.0	20.1	3.95	4.39	4.60
5-methylchrysene	6.33	6.98	5.29	6.73	9.2	8.89	12.1	8.61	10.6	8.29	7.05	6.59	6.63	9.68	6.82	0.00	0.00	0.00
Benzo(b)fluoranthene	2.68	2.85	1.67	2.00	1.91	2.31	1.85	2.33	2.65	2.30	1.51	2.45	2.81	3.61	1.88	1.49	1.26	1.09
Benzo(k)fluoranthene	0.88	0.99	1.24	1.16	0.85	1.20	0.82	1.10	0.82	1.00	0.90	1.24	1.07	0.89	1.25	2.10	1.91	1.38
Benzo(e)pyrene	5.68	3.33	2.55	4.67	3.54	3.84	4.02	5.84	5.33	3.84	4.55	4.54	4.52	3.93	3.88	4.13	3.57	3.13
Benzo(a)pyrene	1.76	1.20	1.39	1.54	1.66	1.49	1.50	1.91	1.68	0.93	1.00	1.16	1.65	1.68	1.16	5.09	2.53	5.26
Perylene	2.43	3.40	2.48	3.12	3.10	3.03	4.09	2.17	3.32	2.79	3.46	3.16	2.32	2.85	1.83	4.21	3.71	3.70
Indeno(1,2,3-cd)pyrene	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.16	0.00	0.26	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	2.59	2.03
Benzo(g,h,i)perylene	1.38	2.44	2.03	2.44	1.34	2.00	1.96	2.51	2.43	2.77	2.07	1.62	1.59	2.97	1.71	1.41	1.41	1.21
ΣPAH	88.1	89.3	82.2	96	88.2	97	99	106	99	92.3	87.4	84.3	95.8	104	91.0	36.6	32.2	31.4

Table A.21. Summary of raw results (µg/Kg, dry wt) for diploid oysters - November 2011.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	0.61	0.78	0.79	1.29	0.80	1.11	1.33	1.02	1.39	0.94	0.70	0.85	0.64	0.96	0.60	0.75	1.12	0.82
Benzothiophene	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.24	0.00	0.28	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	0.74	0.42	0.48	0.85	0.69	0.78	0.56	0.90	0.60	0.72	0.84	0.61	1.08	0.48	0.67	0.49	0.65	0.45
Biphenyl	3.16	4.66	2.13	2.73	2.97	2.43	4.49	3.32	3.58	2.52	2.13	1.81	2.50	2.55	2.34	0.00	0.00	0.00
2-ethylnaphthalene	1.62	1.23	1.28	1.32	1.46	1.44	1.52	1.64	1.63	1.14	1.04	1.25	1.89	1.33	1.08	0.00	0.00	0.00
Acenaphthylene	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00	0.36	0.00	0.41	0.00	0.00	0.00	0.00	0.00
Acenaphthene	1.03	1.25	1.15	1.42	0.97	1.02	1.47	1.04	1.09	1.15	1.22	0.81	0.71	1.53	1.37	0.00	0.00	0.00
Dibenzofuran	1.53	3.42	1.85	2.29	2.44	2.71	3.14	2.02	2.92	1.47	1.83	1.20	1.44	2.81	2.20	0.30	0.23	0.25
Fluorene	1.30	0.97	0.67	1.25	1.18	1.04	1.02	1.58	1.24	0.73	0.54	1.20	1.34	1.02	1.20	0.72	0.75	0.63
Dibenzothiophene	0.70	1.76	0.68	1.51	1.03	1.44	1.66	0.99	1.46	0.91	1.13	0.57	0.59	1.72	1.27	0.67	0.53	0.51
Phenanthrene	2.44	2.87	2.81	3.14	3.60	3.18	3.75	6.76	6.69	3.21	4.59	3.27	2.55	3.98	2.69	1.66	1.24	0.96
Anthracene	0.50	0.55	0.64	0.66	0.72	0.98	0.58	0.66	1.09	0.68	0.48	0.57	0.80	0.69	0.83	0.38	0.30	0.25
Carbozole	1.41	0.93	1.70	2.41	1.49	3.11	2.16	1.61	1.88	1.63	0.97	1.82	1.55	1.37	1.42	0.00	0.00	0.00
4-methyldibenzothiophene	1.82	1.54	1.72	3.92	3.48	4.53	2.41	3.75	1.95	2.64	1.93	1.90	3.01	2.11	2.08	0.00	0.00	0.00
2-methylphenanthrene	4.96	2.66	6.52	8.42	5.32	7.84	6.67	7.06	4.34	5.00	5.22	3.94	5.88	3.34	5.64	0.72	0.66	0.62
2-methylanthracene	4.12	2.47	3.12	3.72	4.03	3.22	3.99	4.55	3.64	3.11	2.30	3.00	3.13	3.31	2.83	0.00	0.00	0.00
1-methylphenanthrene	5.84	6.02	7.88	12.0	7.69	12.9	7.80	12.1	9.00	9.89	5.14	5.43	9.32	7.53	8.70	0.00	0.00	0.00
3,6-dimethylphenanthrene	4.72	7.18	4.41	8.95	6.72	11.0	8.85	5.35	7.65	5.13	6.42	6.47	5.05	8.58	4.86	1.04	0.65	0.70
Fluoranthene	3.29	2.33	2.44	3.87	2.65	3.46	3.19	3.01	3.95	3.13	2.48	2.94	3.21	2.59	2.60	1.13	1.20	0.90
Pyrene	2.12	2.44	2.89	4.32	3.86	3.98	3.72	4.08	3.29	3.33	3.03	4.24	2.90	4.62	3.51	0.94	0.84	0.82
Benzo(a)fluorene	2.01	1.48	1.32	2.77	3.52	5.30	2.98	4.43	2.60	2.86	2.07	2.18	2.72	1.92	2.31	0.00	0.00	0.00
1-methylpyrene	5.38	4.38	4.91	5.19	4.56	4.31	5.61	5.48	5.32	5.23	3.94	4.73	5.05	6.07	4.77	0.70	0.75	0.76
Benzo(a)anthracene	2.38	3.70	2.19	3.69	3.69	3.49	4.84	5.04	3.00	3.53	2.62	3.68	2.86	3.09	3.04	3.83	2.35	2.88
Chrysene	13.6	19.2	13.2	15.8	17.9	15.5	17.8	19.4	19.4	17.8	18.8	17.5	14.5	17.7	18.5	4.64	5.00	5.19
5-methylchrysene	7.68	7.88	5.79	10.5	12.5	12.1	10.9	12.2	9.91	9.66	7.64	9.70	8.87	11.4	7.21	0.00	0.00	0.00
Benzo(b)fluoranthene	2.03	2.95	1.28	3.37	2.87	3.08	2.14	2.85	3.27	1.52	1.91	2.66	1.87	3.77	1.43	1.84	1.39	1.14
Benzo(k)fluoranthene	0.90	1.17	1.22	2.21	1.26	1.13	1.11	1.35	1.03	1.50	0.94	1.10	1.22	1.05	1.26	2.35	1.52	1.28
Benzo(e)pyrene	4.75	2.66	2.96	6.07	5.52	5.14	6.35	5.59	7.62	4.64	4.93	5.65	4.09	3.74	5.21	4.90	4.65	3.02
Benzo(a)pyrene	1.72	1.42	1.74	2.71	1.81	1.60	2.18	1.88	2.43	1.18	1.01	1.27	1.57	1.22	1.68	4.86	3.40	5.39
Perylene	3.46	3.98	2.23	2.98	3.10	4.94	3.97	3.75	3.69	2.74	2.88	2.68	2.08	3.08	1.96	4.18	3.60	4.28
Indeno(1,2,3-cd)pyrene	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.17	0.00	0.27	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.83	2.99	2.05
Benzo(g,h,i)perylene	1.58	2.85	2.06	2.58	1.54	3.24	2.76	2.57	2.92	2.44	2.43	1.84	1.23	3.23	1.99	1.74	1.27	1.38
ΣPAH	88.2	95.2	82.1	122	109	126	119	127	119	100	91.9	94.8	94.6	107	95.3	40.7	35.1	34.3

Table A.22. Summary of raw results (µg/Kg, dry wt) for diploid oysters - February 2012.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	0.47	0.90	0.77	0.96	0.97	0.75	0.99	1.04	0.93	0.72	0.62	0.76	0.58	0.88	0.80	1.00	1.07	0.83
Benzothiophene	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.21	0.00	0.25	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	0.68	0.50	0.43	0.70	0.63	0.83	0.65	0.77	0.57	0.71	0.90	0.56	0.79	0.42	0.65	0.43	0.82	0.56
Biphenyl	2.35	2.93	1.80	2.78	2.33	2.41	2.61	3.33	3.28	2.33	1.75	1.54	1.90	2.99	2.81	0.00	0.00	0.00
2-ethylnaphthalene	1.63	1.22	0.77	1.38	1.18	1.00	1.46	1.66	2.05	0.99	1.06	1.25	1.46	1.36	0.80	0.00	0.00	0.00
Acenaphthylene	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.00	0.00	0.36	0.00	0.43	0.00	0.00	0.00	0.00	0.00
Acenaphthene	0.78	0.96	0.69	1.26	0.81	1.04	1.10	1.34	1.00	1.29	1.07	0.66	0.58	1.35	0.98	0.00	0.00	0.00
Dibenzofuran	1.60	2.64	1.88	2.83	2.61	2.44	2.87	2.03	1.88	1.42	1.77	1.27	1.50	2.14	1.85	0.30	0.24	0.27
Fluorene	1.12	1.28	0.66	0.97	1.24	0.96	0.98	1.09	1.06	0.87	0.45	0.96	1.25	1.22	0.79	0.80	0.86	0.68
Dibenzothiophene	0.68	1.52	0.81	1.25	1.04	1.22	1.48	0.99	0.86	0.69	0.92	0.67	0.58	1.77	1.20	0.69	0.57	0.47
Phenanthrene	2.38	3.16	3.08	3.16	3.52	3.06	3.24	5.25	4.42	2.88	4.19	4.14	3.09	3.60	3.27	1.48	1.20	0.88
Anthracene	0.44	0.66	0.77	0.77	0.52	0.65	0.59	0.78	0.73	0.62	0.49	0.62	0.66	0.76	0.72	0.36	0.33	0.29
Carbozole	1.22	0.97	1.52	2.02	1.23	2.11	2.24	1.78	1.81	1.80	0.98	1.39	1.40	1.15	1.35	0.00	0.00	0.00
4-methyldibenzothiophene	2.27	1.39	1.33	3.89	2.62	4.15	2.40	5.16	2.45	2.63	1.88	1.75	2.55	1.87	1.76	0.00	0.00	0.00
2-methylphenanthrene	5.34	3.02	4.38	6.68	6.59	5.50	5.96	6.48	5.07	3.85	6.68	3.91	4.85	4.71	5.01	0.83	0.66	0.70
2-methylanthracene	3.27	2.47	2.44	3.36	3.06	2.60	2.90	3.13	3.47	2.78	2.29	2.65	2.48	3.09	3.51	0.00	0.00	0.00
1-methylphenanthrene	5.21	4.50	6.11	6.93	7.62	12.3	6.61	11.8	10.7	7.51	6.20	6.24	10.5	6.12	8.61	0.00	0.00	0.00
3,6-dimethylphenanthrene	3.65	5.12	3.74	8.93	8.52	7.35	8.25	7.63	7.65	4.62	4.79	6.85	5.42	7.31	4.45	1.12	0.77	0.82
Fluoranthene	2.74	2.72	2.38	3.30	2.63	2.93	2.91	2.99	4.00	3.12	3.55	2.46	2.35	3.05	2.54	1.27	1.16	0.98
Pyrene	2.03	2.51	3.25	3.81	3.25	2.84	3.17	3.64	3.19	2.96	2.51	3.04	3.06	4.80	4.79	1.26	1.12	0.81
Benzo(a)fluorene	2.13	1.19	1.49	3.10	2.62	2.97	3.31	3.91	2.33	2.30	1.62	1.54	2.53	2.33	1.61	0.00	0.00	0.00
1-methylpyrene	5.18	4.03	4.45	4.94	4.18	4.15	4.98	5.11	4.07	4.14	3.44	3.58	5.92	5.35	5.84	0.68	0.66	0.78
Benzo(a)anthracene	1.84	3.32	1.74	3.19	3.11	3.34	4.52	4.56	3.35	3.29	2.17	3.56	2.51	3.93	3.28	3.18	2.28	2.30
Chrysene	11.4	13.4	13.3	21.6	17.9	11.0	19.3	22.9	20.0	14.7	14.9	14.1	17.7	21.2	17.1	4.69	5.77	4.80
5-methylchrysene	5.99	6.98	5.21	11.2	8.95	9.33	11.3	8.02	10.2	7.87	9.46	8.69	6.30	8.5	5.90	0.00	0.00	0.00
Benzo(b)fluoranthene	1.88	2.18	1.45	2.45	2.47	3.45	2.74	2.80	2.61	2.32	1.82	2.63	1.93	3.21	1.55	2.12	1.36	1.30
Benzo(k)fluoranthene	1.05	0.73	1.10	2.08	1.17	1.23	1.01	1.01	1.07	1.33	1.01	1.08	0.88	0.81	0.82	2.40	2.01	1.60
Benzo(e)pyrene	4.42	2.64	2.75	6.94	5.01	5.09	5.88	6.38	5.27	3.96	3.85	4.61	3.81	3.71	3.85	4.01	4.99	3.87
Benzo(a)pyrene	1.62	1.43	1.31	1.72	1.40	1.79	1.68	1.62	2.04	1.40	0.75	1.13	1.90	1.35	1.49	6.36	2.99	6.40
Perylene	2.28	4.44	2.00	2.60	3.05	3.79	4.16	3.37	4.88	2.78	3.10	2.25	2.65	3.04	1.75	4.71	3.91	3.63
Indeno(1,2,3-cd)pyrene	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.13	0.00	0.20	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.13	3.02	2.30
Benzo(g,h,i)perylene	1.38	2.08	1.72	2.19	1.48	3.01	1.96	2.72	2.78	3.23	2.17	1.65	1.62	2.32	1.81	1.82	1.62	1.40
ΣPAH	77.7	80.8	73.3	117	102	103	111	124	114	89.2	87.1	85.6	93.6	104	90.9	42.6	37.4	35.7

Table A.23. Summary of raw results (µg/Kg, dry wt) for diploid oysters - May 2012.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	0.41	0.65	0.75	0.93	0.77	0.84	1.00	0.75	0.74	0.66	0.42	0.57	0.41	0.75	0.59	0.85	1.20	0.67
Benzothiophene	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.22	0.00	0.21	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	0.46	0.44	0.45	0.65	0.57	0.77	0.55	0.71	0.38	0.49	0.54	0.39	0.61	0.47	0.49	0.43	0.80	0.50
Biphenyl	1.81	2.44	1.61	2.02	1.73	1.36	2.90	2.47	2.79	1.86	1.43	1.32	1.52	2.83	2.27	0.00	0.00	0.00
2-ethylnaphthalene	1.22	1.14	0.94	0.90	0.73	0.80	1.33	1.27	1.39	0.81	1.06	0.96	1.61	1.04	0.71	0.00	0.00	0.00
Acenaphthylene	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.25	0.00	0.30	0.00	0.00	0.00	0.00	0.00
Acenaphthene	0.68	0.84	0.82	0.99	0.73	0.76	0.84	0.95	1.11	0.83	0.70	0.58	0.63	1.24	0.81	0.00	0.00	0.00
Dibenzofuran	1.00	2.18	1.57	1.75	1.94	2.37	2.68	1.40	2.11	1.35	1.39	0.97	1.14	1.91	1.55	0.26	0.20	0.26
Fluorene	0.97	0.77	0.48	0.75	0.83	0.71	1.08	1.33	0.74	0.65	0.45	0.83	0.82	0.92	0.77	0.85	0.88	0.61
Dibenzothiophene	0.51	1.17	0.68	1.02	0.81	0.99	1.14	0.70	1.04	0.63	0.74	0.55	0.69	1.01	0.92	0.75	0.49	0.49
Phenanthrene	1.67	2.32	1.99	2.11	2.37	2.40	2.70	4.63	4.29	1.89	3.34	3.01	2.87	3.23	2.49	1.44	1.01	1.03
Anthracene	0.34	0.47	0.50	0.54	0.41	0.57	0.47	0.63	0.69	0.47	0.42	0.41	0.59	0.47	0.55	0.37	0.32	0.25
Carbozole	0.85	0.79	1.10	1.54	1.28	1.63	1.42	1.07	1.47	1.58	0.73	1.20	1.29	1.25	1.67	0.00	0.00	0.00
4-methyldibenzothiophene	2.15	1.45	0.88	2.98	2.26	3.25	2.44	3.95	1.84	2.01	1.65	1.39	2.44	1.33	1.06	0.00	0.00	0.00
2-methylphenanthrene	4.21	2.13	3.94	5.56	4.92	5.56	4.73	6.07	4.68	3.24	4.91	3.32	5.34	3.55	4.14	0.84	0.65	0.67
2-methylanthracene	1.83	1.49	2.49	2.14	1.71	1.81	2.25	3.37	2.79	2.14	1.92	2.14	2.73	1.96	2.45	0.00	0.00	0.00
1-methylphenanthrene	5.36	4.14	5.33	5.52	5.85	8.4	4.24	9.5	7.31	6.10	5.27	3.64	8.76	6.32	6.01	0.00	0.00	0.00
3,6-dimethylphenanthrene	2.90	5.71	2.98	6.83	6.28	6.00	6.42	4.70	6.00	4.72	4.26	3.95	4.76	6.54	4.38	1.22	0.68	0.80
Fluoranthene	2.47	1.90	1.99	2.25	2.01	1.81	2.99	2.41	3.19	2.18	2.48	1.92	2.47	2.61	1.70	1.25	1.13	1.01
Pyrene	1.83	2.13	2.99	3.00	2.19	2.63	3.55	2.47	3.24	2.56	2.00	2.87	2.20	3.56	3.46	1.36	1.04	0.90
Benzo(a)fluorene	1.60	1.35	1.49	2.64	2.07	3.18	3.05	3.15	1.52	1.98	1.88	1.55	2.27	1.22	1.24	0.00	0.00	0.00
1-methylpyrene	3.87	3.55	3.17	3.62	3.47	2.59	3.20	3.90	3.67	3.56	3.01	4.03	3.93	4.03	4.66	0.69	0.66	0.64
Benzo(a)anthracene	1.91	2.50	1.50	2.08	2.38	2.79	3.66	3.71	2.68	2.42	2.31	2.33	2.19	2.27	2.79	3.39	2.45	2.71
Chrysene	10.9	14.0	11.9	14.3	14.1	12.0	14.8	16.4	14.3	14.2	9.6	13.5	14.6	13.8	12.9	4.74	4.68	5.48
5-methylchrysene	5.13	6.99	4.63	6.40	9.14	9.84	8.73	5.76	7.65	5.44	6.82	6.14	7.18	7.6	5.45	0.00	0.00	0.00
Benzo(b)fluoranthene	1.96	2.38	1.42	1.80	1.95	2.71	1.76	2.52	1.80	1.43	1.16	1.79	2.44	2.47	1.21	1.78	1.58	1.21
Benzo(k)fluoranthene	0.96	0.71	0.99	1.33	0.90	1.24	0.89	1.01	0.59	0.88	0.76	0.97	0.83	0.68	0.78	2.20	2.05	1.44
Benzo(e)pyrene	3.30	2.52	2.50	5.29	3.23	3.44	4.54	4.64	4.57	3.81	3.55	3.08	4.25	2.91	2.76	5.29	4.02	3.18
Benzo(a)pyrene	1.00	1.06	1.25	1.38	1.28	1.34	1.06	1.37	1.49	1.06	0.65	1.09	1.23	1.41	0.90	5.14	3.02	5.81
Perylene	2.68	2.91	1.54	2.19	2.00	3.48	3.84	2.84	3.40	2.02	2.74	2.53	1.66	2.83	1.75	3.99	4.62	4.06
Indeno(1,2,3-cd)pyrene	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.11	0.00	0.19	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.33	2.82	2.14
Benzo(g,h,i)perylene	1.13	2.10	1.74	2.08	1.07	2.30	1.53	2.42	2.17	2.14	1.49	1.47	1.00	1.81	1.39	2.12	1.61	1.38
ΣPAH	65.6	72.2	63.6	84.6	78.9	87.5	89.8	96.9	89.6	73.2	68.3	68.5	83.2	82	71.9	42.3	35.9	35.3

Table A.24.Summary of raw results (µg/Kg, dry wt) for diploid oysters - August 2012.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	0.22	0.48	0.45	0.70	0.49	0.60	0.45	0.54	0.60	0.35	0.42	0.53	0.26	0.32	0.38	0.78	1.19	0.87
Benzothiophene	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.15	0.00	0.13	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	0.39	0.28	0.26	0.32	0.39	0.39	0.35	0.49	0.28	0.36	0.37	0.23	0.38	0.26	0.30	0.47	0.75	0.45
Biphenyl	1.55	1.41	1.08	1.13	1.39	1.17	2.10	1.69	1.75	1.18	1.15	1.25	1.18	1.80	0.90	0.00	0.00	0.00
2-ethylnaphthalene	0.69	0.65	0.47	0.81	0.52	0.50	0.91	0.92	0.88	0.63	0.83	0.52	0.77	0.58	0.43	0.00	0.00	0.00
Acenaphthylene	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.17	0.00	0.20	0.00	0.00	0.00	0.00	0.00
Acenaphthene	0.46	0.52	0.51	0.57	0.50	0.55	0.75	0.69	0.69	0.56	0.48	0.50	0.35	0.58	0.70	0.00	0.00	0.00
Dibenzofuran	0.80	1.47	1.14	1.36	1.44	1.47	1.74	1.05	1.28	1.13	0.97	0.65	0.60	1.43	1.04	0.25	0.26	0.25
Fluorene	0.56	0.58	0.40	0.48	0.55	0.45	0.55	0.85	0.56	0.41	0.24	0.50	0.66	0.60	0.37	0.71	0.72	0.64
Dibenzothiophene	0.37	0.88	0.47	0.84	0.73	0.86	0.89	0.40	0.63	0.59	0.62	0.42	0.32	0.78	0.47	0.57	0.50	0.44
Phenanthrene	1.50	1.89	1.70	1.79	1.48	1.30	2.45	2.12	2.83	1.94	2.44	1.64	1.50	1.63	1.18	1.99	1.01	1.01
Anthracene	0.21	0.42	0.37	0.36	0.30	0.56	0.33	0.38	0.52	0.35	0.34	0.32	0.32	0.25	0.34	0.36	0.29	0.29
Carbozole	0.58	0.48	0.87	1.14	0.73	1.27	1.27	1.04	0.65	0.92	0.47	0.79	0.56	0.54	0.89	0.00	0.00	0.00
4-methyldibenzothiophene	1.04	0.77	0.60	1.49	1.16	2.13	1.79	2.09	1.55	1.28	0.96	1.13	1.54	0.98	0.72	0.00	0.00	0.00
2-methylphenanthrene	3.28	1.50	3.08	3.85	3.34	3.75	2.96	4.57	2.33	2.75	3.25	2.20	2.99	2.09	2.71	0.99	0.88	0.61
2-methylanthracene	1.47	1.20	1.48	1.58	1.61	1.65	2.12	2.08	1.59	1.50	1.02	1.48	1.41	1.56	2.00	0.00	0.00	0.00
1-methylphenanthrene	2.57	2.52	4.11	5.95	2.90	5.4	3.68	5.5	4.79	4.89	3.02	3.62	4.52	2.86	3.61	0.00	0.00	0.00
3,6-dimethylphenanthrene	1.90	2.73	2.01	4.69	4.33	4.56	5.08	2.83	4.27	3.27	2.99	3.12	2.79	4.43	2.58	1.01	0.72	0.84
Fluoranthene	1.86	1.17	1.37	1.68	1.39	1.87	1.92	1.74	1.88	1.25	1.43	1.71	1.06	1.25	0.95	1.21	1.18	1.11
Pyrene	1.36	1.81	1.81	1.64	1.49	1.82	2.05	2.19	2.36	1.92	1.32	1.43	1.10	2.76	2.04	1.26	0.99	0.84
Benzo(a)fluorene	0.90	0.85	0.69	1.40	1.59	1.84	1.95	3.14	0.89	1.01	0.89	0.93	1.16	0.92	0.69	0.00	0.00	0.00
1-methylpyrene	2.63	2.60	3.01	2.82	2.92	1.92	2.45	2.67	2.88	2.14	1.75	2.75	2.72	1.83	2.19	0.71	0.62	0.67
Benzo(a)anthracene	1.30	1.39	1.12	1.35	1.92	1.64	2.58	1.62	1.84	1.81	1.53	1.78	1.72	1.51	1.38	3.95	2.28	2.76
Chrysene	7.03	9.7	5.12	11.4	8.95	6.65	8.42	11.9	8.00	8.15	5.91	8.89	8.74	9.0	7.79	4.96	5.17	6.65
5-methylchrysene	3.00	4.27	2.46	6.10	6.08	4.90	6.15	4.23	6.23	4.73	4.87	4.02	3.47	4.4	3.00	0.00	0.00	0.00
Benzo(b)fluoranthene	1.01	1.59	0.94	1.44	1.11	2.10	1.29	1.41	1.26	0.97	0.73	1.46	1.09	1.61	0.80	1.64	1.61	1.40
Benzo(k)fluoranthene	0.48	0.36	0.58	1.27	0.66	0.73	0.62	0.63	0.54	0.79	0.45	0.49	0.65	0.39	0.40	2.43	2.18	1.87
Benzo(e)pyrene	2.11	1.65	1.68	2.90	2.43	3.14	2.39	3.14	3.51	2.80	2.21	2.41	2.16	2.42	2.14	4.60	4.68	3.35
Benzo(a)pyrene	0.84	0.68	0.84	0.93	1.03	1.22	0.93	0.91	1.25	0.73	0.43	0.57	0.76	0.75	0.77	5.79	3.13	5.56
Perylene	1.19	1.50	1.25	1.70	1.45	1.66	1.99	1.68	1.88	1.45	1.46	1.81	1.15	1.67	1.07	5.41	4.13	4.48
Indeno(1,2,3-cd)pyrene	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.11	0.00	0.10	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.64	3.49	2.01
Benzo(g,h,i)perylene	0.74	0.99	0.88	1.24	0.79	1.47	0.97	1.78	1.98	1.23	1.10	0.86	0.94	1.72	1.05	2.00	1.34	1.53
ΣPAH	42.4	46.3	40.8	63.0	53.6	57.5	61.1	64.9	59.7	51.1	44.1	48.0	47.3	51	42.9	44.7	37.1	37.6

Table A.25. Summary of raw results (µg/Kg, dry wt) for diploid oysters - September 2012.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	0.24	0.43	0.43	0.65	0.54	0.50	0.47	0.60	0.59	0.59	0.40	0.37	0.36	0.42	0.38	0.69	1.01	0.66
Benzothiophene	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.14	0.00	0.14	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	0.38	0.23	0.31	0.46	0.43	0.45	0.44	0.56	0.31	0.38	0.43	0.31	0.40	0.34	0.45	0.35	0.56	0.39
Biphenyl	1.52	2.33	1.27	1.56	1.29	1.28	2.20	1.60	2.64	1.38	1.02	1.19	1.40	1.93	1.11	0.00	0.00	0.00
2-ethylnaphthalene	0.87	0.79	0.50	0.75	0.81	0.87	0.70	1.02	1.12	0.59	0.64	0.74	0.88	0.68	0.61	0.00	0.00	0.00
Acenaphthylene	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.16	0.00	0.26	0.00	0.00	0.00	0.00	0.00
Acenaphthene	0.45	0.60	0.50	0.80	0.61	0.61	0.70	0.54	0.66	0.59	0.48	0.56	0.35	0.57	0.70	0.00	0.00	0.00
Dibenzofuran	0.89	1.85	1.10	1.37	1.14	1.91	1.57	1.29	1.35	1.03	0.97	0.73	0.95	1.33	1.00	0.19	0.20	0.21
Fluorene	0.55	0.61	0.42	0.73	0.77	0.45	0.55	0.84	0.73	0.46	0.35	0.66	0.71	0.55	0.48	0.63	0.63	0.55
Dibenzothiophene	0.41	0.74	0.45	0.64	0.68	0.77	0.81	0.47	0.70	0.58	0.62	0.44	0.43	0.61	0.60	0.58	0.42	0.36
Phenanthrene	1.27	1.69	1.79	1.81	1.59	1.73	2.78	2.59	2.47	2.14	2.40	1.94	1.65	2.12	1.34	1.13	0.83	0.89
Anthracene	0.29	0.39	0.30	0.40	0.37	0.41	0.47	0.46	0.42	0.33	0.25	0.30	0.32	0.38	0.44	0.30	0.26	0.28
Carbozole	0.58	0.49	0.68	1.30	1.16	1.43	1.31	1.04	1.09	0.95	0.65	0.80	0.72	0.84	0.92	0.00	0.00	0.00
4-methyldibenzothiophene	1.30	0.77	0.74	1.56	1.55	2.05	1.92	2.46	1.09	1.21	1.14	1.13	1.58	1.11	1.20	0.00	0.00	0.00
2-methylphenanthrene	3.33	1.47	3.20	4.82	2.56	3.71	3.80	4.98	2.18	2.15	3.70	2.02	3.29	2.26	3.25	0.70	0.56	0.58
2-methylanthracene	2.12	1.24	1.94	1.55	1.98	1.31	2.47	1.92	2.45	1.72	1.12	1.35	2.22	1.30	1.38	0.00	0.00	0.00
1-methylphenanthrene	3.14	2.98	4.34	4.99	3.53	7.7	3.40	5.4	6.43	4.18	4.05	2.42	4.93	3.94	4.33	0.00	0.00	0.00
3,6-dimethylphenanthrene	2.55	3.53	2.27	4.02	3.80	4.76	4.16	3.15	4.22	2.71	4.41	4.16	2.33	3.92	2.99	0.88	0.59	0.59
Fluoranthene	1.40	1.22	1.40	1.63	1.36	1.93	1.52	1.71	2.56	2.07	2.18	1.64	1.18	1.81	1.29	1.05	0.89	0.83
Pyrene	1.36	1.45	1.71	2.08	1.77	1.95	2.05	2.44	1.94	1.92	1.80	2.12	1.85	2.42	1.58	1.03	0.90	0.64
Benzo(a)fluorene	1.14	0.98	0.80	2.12	1.71	2.39	1.94	2.46	1.21	1.10	1.20	1.07	1.34	0.93	0.91	0.00	0.00	0.00
1-methylpyrene	2.87	2.90	2.86	2.88	2.92	2.37	2.74	4.03	2.16	2.51	2.42	2.09	2.46	2.57	2.37	0.54	0.66	0.56
Benzo(a)anthracene	1.29	2.00	1.14	1.83	1.71	2.31	2.69	1.76	1.61	2.12	1.39	1.72	1.74	1.90	1.72	2.23	2.18	2.03
Chrysene	8.18	9.70	7.19	8.72	9.06	8.25	8.26	14.3	9.31	8.15	6.82	9.48	6.81	11.2	9.13	3.66	5.14	4.74
5-methylchrysene	3.34	4.12	2.97	6.16	6.61	7.06	6.03	5.60	4.62	5.00	4.55	3.91	3.90	5.0	2.75	0.00	0.00	0.00
Benzo(b)fluoranthene	1.28	1.83	0.68	1.33	1.37	2.06	1.18	1.68	1.57	1.00	0.84	1.46	1.66	1.73	0.95	1.35	1.47	1.10
Benzo(k)fluoranthene	0.61	0.54	0.84	1.06	0.67	0.82	0.74	0.66	0.51	0.55	0.48	0.52	0.71	0.59	0.64	1.85	1.59	1.28
Benzo(e)pyrene	2.71	1.96	1.33	3.45	2.83	2.87	2.79	3.37	3.38	3.24	1.94	3.06	2.59	2.25	1.73	3.43	3.42	2.45
Benzo(a)pyrene	1.06	0.61	0.73	1.19	0.92	0.99	0.98	0.92	1.31	0.70	0.54	0.69	0.87	0.93	0.90	5.25	2.62	4.07
Perylene	1.44	2.15	1.39	1.49	1.48	2.03	2.74	2.27	1.89	1.90	1.99	1.26	1.62	1.87	1.35	3.60	3.50	3.05
Indeno(1,2,3-cd)pyrene	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.09	0.00	0.12	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.61	2.37	1.91
Benzo(g,h,i)perylene	0.88	1.13	1.00	1.50	0.82	1.71	1.25	1.57	1.57	1.83	0.90	1.37	0.91	1.86	1.06	1.41	1.26	1.17
ΣPAH	47.8	50.7	44.3	62.8	56.0	66.7	62.6	72.4	62.1	53.1	50.1	49.5	50.7	57	47.6	33.5	31.0	28.3

Table A.26. Summary of raw results (µg/Kg, dry wt) for triploid oysters - July 2011.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	0.50	0.75	0.76	0.85	0.83	1.08	0.91	1.09	0.87	0.74	0.59	0.78	0.76	1.08	0.80	0.80	0.96	0.66
Benzothiophene	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.00	0.00	0.23	0.00	0.31	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	0.73	0.53	0.44	0.80	0.65	0.57	0.63	0.79	0.45	0.56	0.77	0.59	0.80	0.42	0.78	0.39	0.55	0.38
Biphenyl	2.68	2.75	1.63	2.84	2.77	2.41	3.64	3.37	3.35	2.60	1.55	1.73	2.32	3.53	2.73	0.00	0.00	0.00
2-ethylnaphthalene	1.51	1.04	0.77	1.14	1.18	1.27	1.22	1.30	1.99	1.12	1.33	1.20	1.83	1.45	1.27	0.00	0.00	0.00
Acenaphthylene	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.42	0.00	0.35	0.00	0.00	0.00	0.00	0.00
Acenaphthene	0.93	1.03	0.89	1.42	0.92	0.92	1.28	1.14	1.10	1.02	0.95	0.91	0.86	1.51	1.21	0.00	0.00	0.00
Dibenzofuran	1.29	2.42	1.59	2.74	1.87	2.35	3.46	2.11	2.25	2.01	2.37	1.14	1.51	3.09	2.39	0.28	0.25	0.21
Fluorene	1.04	0.90	0.64	1.13	0.89	1.10	0.84	1.37	1.26	0.90	0.67	1.24	1.38	1.25	0.93	0.71	0.62	0.66
Dibenzothiophene	0.67	1.19	0.64	1.47	0.99	1.41	1.60	0.93	1.01	0.98	0.86	0.53	0.73	1.53	1.20	0.53	0.46	0.46
Phenanthrene	2.63	3.76	3.14	3.68	2.96	3.38	3.67	4.23	4.83	3.58	4.07	3.49	3.59	3.66	2.40	1.07	1.24	0.84
Anthracene	0.49	0.72	0.72	0.69	0.56	0.96	0.82	0.70	0.99	0.73	0.60	0.48	0.83	0.84	0.88	0.34	0.30	0.22
Carbozole	1.36	0.87	1.27	1.84	1.96	2.33	2.16	1.80	1.27	1.70	0.93	1.36	1.75	1.30	1.73	0.00	0.00	0.00
4-methyldibenzothiophene	2.23	1.24	1.32	2.65	2.57	3.25	2.73	4.38	2.18	2.40	2.24	1.52	2.49	2.38	1.73	0.00	0.00	0.00
2-methylphenanthrene	5.28	2.61	5.04	7.27	5.04	7.62	7.66	6.28	5.44	4.58	5.55	4.12	6.94	3.89	6.03	0.85	0.63	0.68
2-methylanthracene	2.49	2.15	2.54	2.99	2.83	2.83	3.42	3.83	4.02	3.11	2.65	2.73	2.73	2.51	3.86	0.00	0.00	0.00
1-methylphenanthrene	6.22	6.10	5.91	8.23	7.14	11.7	7.79	10.7	10.2	6.57	5.40	6.98	9.05	8.15	7.31	0.00	0.00	0.00
3,6-dimethylphenanthrene	5.03	6.16	3.90	7.20	8.03	9.22	8.17	5.29	6.48	4.92	5.72	5.83	4.87	7.67	5.83	0.84	0.61	0.64
Fluoranthene	3.34	2.23	1.99	2.95	2.36	3.60	3.24	2.63	4.23	3.13	3.31	2.92	2.73	2.49	2.83	1.10	0.96	0.88
Pyrene	2.13	3.01	3.61	3.81	3.59	2.76	4.05	3.79	4.05	2.60	2.14	3.68	3.76	4.38	3.36	1.04	0.90	0.81
Benzo(a)fluorene	1.66	1.20	1.40	2.77	2.90	4.52	3.19	3.76	2.59	1.80	1.83	2.17	2.61	1.62	2.24	0.00	0.00	0.00
1-methylpyrene	4.76	4.26	4.90	3.79	4.14	4.96	3.67	4.90	5.51	3.17	4.48	4.02	4.44	5.72	4.23	0.69	0.69	0.58
Benzo(a)anthracene	2.03	2.53	2.53	3.03	3.76	3.31	4.84	3.86	3.94	3.24	3.21	3.07	3.20	3.55	2.91	2.94	2.43	2.37
Chrysene	10.4	15.7	14.5	16.5	19.5	16.1	16.0	20.1	18.9	11.8	14.4	14.4	16.2	21.4	17.0	3.79	4.97	4.60
5-methylchrysene	5.54	7.95	5.52	11.6	10.4	12.3	13.6	10.3	11.9	8.81	8.25	7.95	7.73	12.1	6.39	0.00	0.00	0.00
Benzo(b)fluoranthene	1.74	2.79	1.69	2.31	2.75	3.58	2.58	3.04	3.32	1.67	1.59	2.38	2.62	2.88	1.91	1.42	1.33	1.20
Benzo(k)fluoranthene	0.72	0.95	1.20	1.63	1.17	1.46	1.13	1.23	0.92	1.18	1.13	1.36	1.23	1.01	1.25	2.08	1.63	1.35
Benzo(e)pyrene	4.23	2.41	3.07	6.93	4.37	4.50	4.71	5.78	6.44	3.97	3.61	4.04	4.58	3.68	3.83	4.16	3.48	3.30
Benzo(a)pyrene	1.81	1.00	1.27	2.14	1.75	1.88	1.73	1.91	2.01	0.95	0.95	1.34	1.68	1.56	1.86	5.06	2.54	5.28
Perylene	2.95	3.95	1.80	3.40	2.90	3.99	4.35	3.33	3.58	2.28	3.58	2.79	2.30	4.07	2.63	4.39	3.46	3.32
Indeno(1,2,3-cd)pyrene	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.20	0.00	0.23	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.76	2.57	2.17
Benzo(g,h,i)perylene	1.35	2.50	1.64	2.55	1.78	2.06	2.36	2.36	3.20	2.58	2.02	1.76	1.37	3.39	2.20	1.56	1.26	1.24
ΣPAH	78.5	84.7	76.3	110	103	117	115	118	118	84.7	87.6	86.6	97.8	112	93.7	36.8	31.9	31.8

Table A.27. Summary of raw results (µg/Kg, dry wt) for triploid oysters - September 2011.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	0.64	0.94	1.05	1.29	1.19	1.27	1.38	1.33	1.42	1.16	0.73	0.71	0.76	1.22	0.92	0.88	1.38	0.70
Benzothiophene	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.29	0.00	0.32	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	0.85	0.62	0.63	1.01	0.70	0.88	0.83	0.89	0.66	0.66	0.86	0.69	1.04	0.59	0.88	0.47	0.77	0.45
Biphenyl	3.69	3.39	2.03	2.50	2.50	3.00	4.31	4.14	4.21	2.96	2.13	1.90	2.78	4.58	3.17	0.00	0.00	0.00
2-ethylnaphthalene	1.35	1.81	1.16	1.94	1.72	1.69	2.01	1.97	2.22	1.30	1.23	1.34	2.12	1.78	1.66	0.00	0.00	0.00
Acenaphthylene	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00	0.41	0.00	0.44	0.00	0.00	0.00	0.00	0.00
Acenaphthene	1.11	0.99	0.90	1.50	1.38	1.35	1.39	1.39	1.48	1.66	1.10	1.03	0.76	1.70	1.70	0.00	0.00	0.00
Dibenzofuran	1.90	3.19	1.73	2.60	3.42	3.84	3.84	2.11	2.16	2.47	1.96	1.71	1.99	3.38	2.83	0.33	0.28	0.25
Fluorene	1.58	1.25	0.91	1.19	1.09	1.21	1.07	1.94	1.22	1.01	0.65	1.17	1.51	1.51	1.16	0.89	0.76	0.69
Dibenzothiophene	0.96	1.72	1.02	1.64	1.63	1.48	1.90	1.11	1.12	0.95	1.03	0.70	1.03	1.58	1.33	0.70	0.66	0.52
Phenanthrene	2.42	3.83	3.86	3.86	3.89	4.41	4.72	6.63	6.46	3.80	5.08	3.82	4.20	4.74	3.18	1.61	1.27	1.07
Anthracene	0.62	0.84	0.93	1.01	0.81	0.99	0.78	0.84	0.95	0.75	0.63	0.81	0.89	0.78	0.85	0.47	0.36	0.27
Carbozole	1.65	1.34	1.95	2.47	2.17	2.85	2.16	2.46	2.33	1.59	1.24	2.38	1.43	1.63	1.86	0.00	0.00	0.00
4-methyldibenzothiophene	2.02	1.57	1.83	3.28	3.82	4.94	4.11	6.27	2.20	3.07	2.66	2.65	4.08	2.00	2.19	0.00	0.00	0.00
2-methylphenanthrene	7.28	3.93	5.19	7.87	7.88	8.74	7.81	11.4	6.96	5.62	8.20	4.17	7.12	4.63	6.51	0.91	0.77	0.73
2-methylanthracene	4.15	2.09	2.92	3.56	3.38	3.81	5.35	4.10	4.13	3.45	2.75	3.01	4.02	2.99	3.49	0.00	0.00	0.00
1-methylphenanthrene	8.31	7.79	6.46	13.6	10.3	12.1	8.23	12.2	11.8	10.3	5.62	7.66	10.6	9.95	9.17	0.00	0.00	0.00
3,6-dimethylphenanthrene	6.01	8.47	6.20	12.0	8.51	9.59	9.81	7.46	9.98	7.76	6.23	8.41	7.51	8.52	5.85	1.10	0.90	0.82
Fluoranthene	3.44	2.70	2.67	3.13	2.97	4.33	4.51	3.96	5.61	3.61	4.30	2.85	4.36	3.41	2.76	1.37	1.31	1.16
Pyrene	2.60	3.36	3.49	4.59	3.45	4.22	3.76	4.48	3.67	4.18	3.40	3.84	4.45	5.36	4.11	1.15	1.08	0.94
Benzo(a)fluorene	2.12	1.81	1.94	3.29	3.07	5.16	3.45	4.94	2.87	2.17	2.80	2.52	3.08	2.10	2.31	0.00	0.00	0.00
1-methylpyrene	5.01	4.22	6.84	6.43	5.77	5.43	4.63	6.57	6.93	5.09	3.94	5.52	6.86	6.73	4.95	0.74	0.80	0.68
Benzo(a)anthracene	2.87	4.37	2.72	3.24	4.12	4.30	4.95	4.65	3.69	3.77	3.36	3.14	3.94	4.51	4.10	3.58	3.07	2.81
Chrysene	15.1	17.4	18.5	20.8	18.8	16.9	19.8	21.3	18.7	18.2	21.7	18.2	18.4	22.9	25.4	5.03	5.38	5.80
5-methylchrysene	7.43	8.09	5.94	9.90	12.2	12.3	16.0	11.7	14.0	10.2	8.49	7.92	7.95	11.9	8.82	0.00	0.00	0.00
Benzo(b)fluoranthene	2.93	3.43	1.84	2.71	2.77	3.42	2.42	3.36	3.62	2.83	1.78	2.98	3.33	4.48	2.34	1.89	1.60	1.40
Benzo(k)fluoranthene	1.03	1.09	1.42	1.61	1.21	1.61	1.14	1.47	1.16	1.17	1.11	1.48	1.33	1.15	1.61	2.67	2.37	1.72
Benzo(e)pyrene	6.29	3.68	3.09	6.15	4.91	5.33	5.55	8.01	7.64	4.68	5.59	5.60	5.72	4.64	4.97	5.01	4.59	3.77
Benzo(a)pyrene	2.01	1.35	1.64	2.15	2.22	2.12	2.01	2.56	2.46	1.14	1.27	1.48	1.94	2.11	1.45	6.15	3.13	6.50
Perylene	2.92	3.87	2.79	4.38	4.09	4.32	6.01	3.09	4.58	3.54	4.29	3.72	2.76	3.68	2.31	5.34	4.75	4.37
Indeno(1,2,3-cd)pyrene	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.20	0.00	0.31	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.09	3.33	2.42
Benzo(g,h,i)perylene	1.53	2.85	2.29	3.22	1.81	2.79	2.79	3.45	3.40	3.40	2.50	1.92	2.02	3.60	2.14	1.78	1.71	1.50
ΣPAH	101	102	93.9	133	122	134	137	147	138	113	108	103	119	128	114	45.2	40.3	38.6

Table A.28. Summary of raw results (µg/Kg, dry wt) for triploid oysters - November 2011.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	0.53	0.73	0.80	1.31	0.74	1.05	1.21	0.99	1.31	0.91	0.62	0.79	0.67	0.92	0.58	0.76	1.10	0.72
Benzothiophene	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.23	0.00	0.27	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	0.66	0.44	0.47	0.78	0.70	0.71	0.58	0.93	0.58	0.64	0.80	0.59	0.94	0.44	0.64	0.44	0.63	0.46
Biphenyl	2.92	4.09	2.17	2.82	2.96	2.13	4.26	3.40	3.32	2.48	1.91	1.84	2.59	2.42	2.21	0.00	0.00	0.00
2-ethylnaphthalene	1.60	1.07	1.13	1.15	1.33	1.28	1.41	1.70	1.51	1.06	1.00	1.29	1.82	1.34	1.06	0.00	0.00	0.00
Acenaphthylene	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00	0.37	0.00	0.38	0.00	0.00	0.00	0.00	0.00
Acenaphthene	0.96	1.13	1.01	1.25	0.97	0.95	1.42	0.98	0.95	1.16	1.22	0.72	0.68	1.36	1.40	0.00	0.00	0.00
Dibenzofuran	1.35	3.14	1.64	2.15	2.43	2.55	3.12	1.80	2.64	1.48	1.79	1.09	1.26	2.60	1.95	0.27	0.23	0.24
Fluorene	1.15	0.99	0.63	1.10	1.02	1.09	0.94	1.64	1.23	0.74	0.51	1.18	1.40	0.99	1.06	0.68	0.76	0.59
Dibenzothiophene	0.73	1.57	0.64	1.53	0.99	1.40	1.45	0.94	1.30	0.89	1.19	0.55	0.62	1.59	1.14	0.60	0.52	0.45
Phenanthrene	2.31	2.85	2.52	3.03	3.42	3.05	3.78	6.13	6.42	3.29	4.07	2.95	2.41	4.18	2.35	1.45	1.08	0.86
Anthracene	0.52	0.54	0.66	0.67	0.64	0.91	0.57	0.65	1.01	0.61	0.47	0.52	0.79	0.67	0.78	0.34	0.32	0.23
Carbozole	1.28	0.83	1.68	2.28	1.47	2.75	2.08	1.61	1.68	1.43	0.93	1.82	1.43	1.32	1.49	0.00	0.00	0.00
4-methyldibenzothiophene	1.89	1.37	1.60	3.73	3.33	4.21	2.44	3.75	1.91	2.39	2.00	1.77	3.12	2.06	2.00	0.00	0.00	0.00
2-methylphenanthrene	4.73	2.45	5.76	7.57	5.02	6.89	5.84	7.40	4.38	4.44	5.49	3.78	5.71	3.33	5.08	0.74	0.69	0.64
2-methylanthracene	3.69	2.31	2.86	3.63	3.64	3.11	3.55	4.17	3.44	3.02	2.21	2.77	2.76	3.09	2.72	0.00	0.00	0.00
1-methylphenanthrene	5.39	5.47	6.97	10.8	7.14	11.6	7.93	11.6	8.98	9.76	4.77	5.01	8.31	7.13	7.61	0.00	0.00	0.00
3,6-dimethylphenanthrene	4.27	7.26	4.19	8.40	7.06	9.64	8.67	5.60	7.24	5.14	6.41	6.47	5.17	8.06	4.69	1.05	0.64	0.64
Fluoranthene	2.95	2.38	2.40	3.49	2.39	3.30	3.02	2.78	3.57	3.10	2.50	3.05	3.11	2.40	2.64	1.17	1.07	0.83
Pyrene	2.02	2.49	3.01	4.36	3.67	3.48	3.43	3.81	3.28	3.34	2.68	4.08	2.94	4.20	3.37	0.95	0.86	0.72
Benzo(a)fluorene	1.95	1.49	1.37	2.52	3.22	4.84	2.80	3.88	2.37	2.56	2.07	2.00	2.76	1.85	2.10	0.00	0.00	0.00
1-methylpyrene	4.90	4.34	4.56	5.16	4.70	3.77	5.32	5.50	5.42	4.60	4.00	4.77	4.68	5.45	4.92	0.65	0.66	0.67
Benzo(a)anthracene	2.33	3.37	2.10	3.77	3.80	3.55	4.54	4.63	3.05	3.64	2.29	3.34	2.95	3.01	3.00	3.50	2.47	2.68
Chrysene	13.6	19.5	12.2	15.6	15.5	14.1	15.6	19.9	17.6	17.0	17.0	17.6	13.7	16.7	16.1	4.55	5.24	5.03
5-methylchrysene	6.89	6.98	5.28	9.71	11.2	12.4	10.4	10.7	8.64	9.18	7.10	8.64	7.92	9.88	7.52	0.00	0.00	0.00
Benzo(b)fluoranthene	1.88	2.81	1.29	3.13	2.76	3.20	2.20	2.89	3.20	1.60	1.78	2.68	1.96	3.31	1.46	1.69	1.39	1.01
Benzo(k)fluoranthene	0.81	1.13	1.28	2.05	1.25	1.17	1.12	1.24	1.08	1.31	0.92	0.98	1.07	1.04	1.20	2.26	1.60	1.34
Benzo(e)pyrene	4.48	2.56	2.94	5.70	4.95	4.60	5.67	5.11	6.77	4.37	4.63	5.31	3.95	3.61	4.69	4.27	4.13	2.97
Benzo(a)pyrene	1.58	1.33	1.60	2.40	1.87	1.63	1.96	1.93	2.15	1.24	0.98	1.31	1.63	1.28	1.56	4.91	3.00	4.81
Perylene	3.08	3.76	2.02	2.73	2.76	4.44	3.71	3.42	3.79	2.64	2.88	2.40	1.97	2.77	2.04	4.30	3.43	3.95
Indeno(1,2,3-cd)pyrene	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.17	0.00	0.24	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.74	2.74	1.94
Benzo(g,h,i)perylene	1.58	2.50	1.95	2.52	1.56	2.90	2.52	2.58	2.83	2.33	2.32	1.62	1.26	3.21	1.79	1.63	1.23	1.26
ΣPAH	82.9	90.9	76.7	115	103	117	112	123	112	96.3	87.3	91.0	90.5	100	89.2	38.9	33.8	32.0

Table A.29. Summary of raw results (µg/Kg, dry wt) for triploid oysters - February 2012.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	0.46	0.87	0.77	0.97	0.98	0.72	0.90	1.06	0.97	0.70	0.59	0.78	0.51	0.90	0.75	0.88	1.08	0.74
Benzothiophene	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.22	0.00	0.22	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	0.62	0.52	0.44	0.64	0.60	0.77	0.64	0.80	0.56	0.64	0.85	0.52	0.78	0.41	0.57	0.41	0.78	0.50
Biphenyl	2.27	2.56	1.60	2.45	2.08	2.13	2.58	3.08	3.13	2.22	1.67	1.58	1.82	2.97	2.53	0.00	0.00	0.00
2-ethylnaphthalene	1.45	1.12	0.78	1.23	1.07	1.00	1.47	1.45	1.83	1.04	1.05	1.30	1.44	1.19	0.82	0.00	0.00	0.00
Acenaphthylene	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.00	0.35	0.00	0.42	0.00	0.00	0.00	0.00	0.00
Acenaphthene	0.76	0.92	0.61	1.12	0.84	1.06	1.13	1.21	0.87	1.24	1.02	0.61	0.57	1.32	0.96	0.00	0.00	0.00
Dibenzofuran	1.44	2.55	1.93	2.78	2.29	2.56	2.82	1.81	1.91	1.46	1.74	1.11	1.53	2.15	1.91	0.30	0.22	0.24
Fluorene	1.00	1.24	0.58	0.91	1.10	0.96	1.01	1.07	0.96	0.78	0.47	0.94	1.11	1.07	0.82	0.80	0.77	0.70
Dibenzothiophene	0.70	1.45	0.71	1.29	0.93	1.07	1.32	0.97	0.88	0.69	0.95	0.68	0.51	1.57	1.05	0.63	0.52	0.49
Phenanthrene	2.10	3.28	3.01	2.81	3.31	2.86	3.26	4.92	4.01	2.86	3.73	3.81	2.91	3.42	2.87	1.32	1.18	0.85
Anthracene	0.40	0.68	0.68	0.78	0.50	0.60	0.58	0.72	0.76	0.58	0.46	0.60	0.57	0.67	0.73	0.37	0.30	0.29
Carbozole	1.27	0.90	1.42	1.79	1.25	1.87	2.03	1.81	1.80	1.62	0.96	1.46	1.24	1.19	1.22	0.00	0.00	0.00
4-methyldibenzothiophene	2.03	1.39	1.38	3.47	2.69	4.03	2.26	4.51	2.34	2.29	1.93	1.65	2.61	1.90	1.63	0.00	0.00	0.00
2-methylphenanthrene	5.57	2.96	3.95	6.81	6.60	5.46	6.01	6.17	4.57	3.52	6.36	3.86	4.80	4.15	4.61	0.81	0.63	0.67
2-methylanthracene	3.21	2.28	2.52	3.43	3.22	2.60	2.99	3.29	3.28	2.90	2.07	2.34	2.45	2.91	3.67	0.00	0.00	0.00
1-methylphenanthrene	4.79	4.21	5.68	7.16	6.79	12.5	6.59	10.8	9.40	7.31	5.91	5.44	10.5	5.34	7.95	0.00	0.00	0.00
3,6-dimethylphenanthrene	3.27	4.97	3.54	8.11	8.58	6.47	8.05	6.64	6.71	4.23	5.02	6.17	5.63	6.39	4.24	1.11	0.69	0.73
Fluoranthene	2.56	2.39	2.42	3.28	2.57	2.62	2.92	2.71	4.18	3.14	3.12	2.56	2.46	3.21	2.49	1.11	1.04	0.89
Pyrene	2.02	2.40	2.99	3.68	3.00	2.96	2.81	3.56	3.18	2.69	2.53	2.87	2.78	4.50	4.29	1.24	0.98	0.82
Benzo(a)fluorene	1.92	1.24	1.31	3.15	2.66	3.09	3.18	3.82	2.06	2.22	1.65	1.57	2.32	2.15	1.64	0.00	0.00	0.00
1-methylpyrene	4.68	3.58	4.26	4.63	4.24	3.85	4.88	4.71	3.80	4.34	3.19	3.43	5.48	4.69	5.09	0.68	0.60	0.70
Benzo(a)anthracene	1.92	3.29	1.75	3.30	3.27	2.93	4.10	4.22	3.10	3.28	1.94	3.12	2.33	3.76	3.12	3.01	2.25	2.35
Chrysene	10.6	13.4	11.9	19.5	18.1	11.6	18.3	21.1	18.2	14.5	13.7	13.2	15.6	18.9	16.8	4.84	5.38	4.94
5-methylchrysene	5.70	6.99	5.36	10.2	8.87	8.48	11.0	7.86	8.93	8.15	8.80	7.84	6.47	8.28	5.17	0.00	0.00	0.00
Benzo(b)fluoranthene	1.90	1.98	1.36	2.42	2.39	3.10	2.40	2.52	2.37	2.09	1.59	2.51	1.78	3.09	1.57	1.88	1.40	1.18
Benzo(k)fluoranthene	1.01	0.75	1.11	1.83	1.22	1.22	1.05	1.05	0.99	1.26	1.03	1.04	0.81	0.73	0.85	2.37	2.00	1.67
Benzo(e)pyrene	4.55	2.67	2.73	6.11	5.09	4.82	5.58	5.66	4.89	3.94	3.89	4.40	3.99	3.74	3.71	4.19	4.78	3.50
Benzo(a)pyrene	1.63	1.33	1.22	1.70	1.36	1.60	1.52	1.65	1.81	1.26	0.65	1.10	1.81	1.33	1.56	6.08	3.01	5.76
Perylene	2.23	3.89	1.93	2.71	2.95	3.62	4.10	3.45	4.33	2.60	3.07	2.29	2.54	2.66	1.60	4.54	4.03	3.73
Indeno(1,2,3-cd)pyrene	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.12	0.00	0.20	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.86	3.15	2.30
Benzo(g,h,i)perylene	1.45	2.04	1.51	2.30	1.39	2.75	1.78	2.57	2.61	2.94	2.06	1.67	1.50	2.16	1.82	1.81	1.53	1.36
ΣPAH	74.2	77.8	69.5	111	99.9	99.3	107	116	104	86.5	82.7	80.5	89.7	96.8	86.1	41.2	36.3	34.4

Table A.30. Summary of raw results for (µg/Kg, dry wt) triploid oysters - May 2012.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	0.40	0.61	0.65	0.90	0.74	0.79	0.95	0.77	0.69	0.59	0.40	0.57	0.42	0.66	0.62	0.81	1.10	0.62
Benzothiophene	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.20	0.00	0.21	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	0.43	0.39	0.39	0.57	0.51	0.69	0.55	0.66	0.35	0.48	0.54	0.38	0.56	0.43	0.44	0.42	0.70	0.46
Biphenyl	1.87	2.13	1.68	2.07	1.63	1.21	2.75	2.26	2.81	1.90	1.35	1.36	1.45	2.49	1.97	0.00	0.00	0.00
2-ethylnaphthalene	1.23	1.05	0.86	0.85	0.73	0.79	1.25	1.32	1.27	0.79	0.98	0.93	1.67	1.07	0.71	0.00	0.00	0.00
Acenaphthylene	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.25	0.00	0.28	0.00	0.00	0.00	0.00	0.00
Acenaphthene	0.60	0.84	0.71	0.86	0.69	0.74	0.78	0.87	1.04	0.83	0.65	0.52	0.60	1.16	0.78	0.00	0.00	0.00
Dibenzofuran	0.96	2.00	1.57	1.61	2.01	2.22	2.56	1.39	1.93	1.22	1.32	0.92	1.16	1.90	1.57	0.25	0.21	0.24
Fluorene	0.96	0.78	0.46	0.76	0.83	0.63	0.95	1.18	0.70	0.64	0.42	0.80	0.85	0.90	0.73	0.81	0.77	0.59
Dibenzothiophene	0.51	1.18	0.68	0.98	0.83	0.93	1.00	0.62	0.92	0.57	0.71	0.50	0.64	0.94	0.90	0.66	0.49	0.43
Phenanthrene	1.75	2.24	1.84	2.10	2.42	2.26	2.68	4.74	4.43	1.97	3.03	2.74	2.72	2.96	2.32	1.42	1.06	0.90
Anthracene	0.35	0.46	0.45	0.54	0.38	0.53	0.49	0.59	0.66	0.42	0.42	0.38	0.54	0.49	0.49	0.35	0.33	0.26
Carbozole	0.83	0.74	1.01	1.49	1.23	1.69	1.35	1.03	1.36	1.55	0.67	1.15	1.21	1.10	1.50	0.00	0.00	0.00
4-methyldibenzothiophene	1.88	1.32	0.88	2.61	2.24	2.91	2.27	3.79	1.64	1.94	1.61	1.28	2.13	1.21	1.10	0.00	0.00	0.00
2-methylphenanthrene	4.02	1.88	3.64	4.99	4.67	4.89	4.94	6.39	4.43	3.00	4.85	3.31	4.84	3.39	4.27	0.76	0.64	0.70
2-methylanthracene	1.89	1.56	2.25	2.16	1.62	1.76	2.32	3.01	2.85	1.96	1.77	1.93	2.39	2.02	2.57	0.00	0.00	0.00
1-methylphenanthrene	5.33	4.24	4.92	5.28	5.44	8.3	4.26	8.87	7.67	5.84	4.84	3.29	7.78	5.93	6.27	0.00	0.00	0.00
3,6-dimethylphenanthrene	2.87	5.49	2.71	6.70	5.53	6.28	6.53	4.48	5.58	4.36	3.93	4.14	4.90	6.55	4.05	1.15	0.66	0.77
Fluoranthene	2.27	1.75	1.77	2.07	1.83	1.89	2.86	2.22	2.86	2.11	2.51	1.76	2.52	2.55	1.78	1.28	1.02	0.95
Pyrene	1.60	2.23	2.93	2.94	2.26	2.63	3.15	2.52	2.84	2.56	1.74	2.96	2.17	3.28	3.07	1.22	1.05	0.89
Benzo(a)fluorene	1.56	1.19	1.33	2.42	1.85	2.94	2.76	3.27	1.45	1.83	1.73	1.36	2.37	1.22	1.23	0.00	0.00	0.00
1-methylpyrene	3.37	3.26	3.06	3.32	3.26	2.72	3.04	4.04	3.64	3.58	2.84	3.67	3.71	3.85	4.14	0.70	0.61	0.67
Benzo(a)anthracene	1.75	2.34	1.55	1.96	2.34	2.50	3.38	3.23	2.58	2.26	2.21	2.21	1.96	2.20	2.55	3.32	2.56	2.49
Chrysene	9.71	14.2	11.6	13.1	12.9	10.9	13.6	15.7	14.8	13.3	9.21	13.3	13.8	12.9	11.9	4.75	4.73	5.55
5-methylchrysene	4.66	6.93	4.12	6.11	8.87	9.20	7.76	5.89	7.71	5.21	6.41	5.60	6.56	7.20	4.92	0.00	0.00	0.00
Benzo(b)fluoranthene	1.80	2.12	1.30	1.68	1.92	2.68	1.68	2.36	1.87	1.29	1.20	1.88	2.13	2.56	1.12	1.85	1.56	1.17
Benzo(k)fluoranthene	0.92	0.72	0.92	1.19	0.78	1.18	0.87	0.95	0.61	0.85	0.74	0.90	0.80	0.60	0.73	2.17	1.96	1.37
Benzo(e)pyrene	3.43	2.54	2.50	4.73	2.97	3.21	4.17	4.31	4.59	3.65	3.29	2.98	3.75	2.61	2.77	4.68	3.92	2.98
Benzo(a)pyrene	0.94	1.05	1.23	1.45	1.27	1.35	1.01	1.30	1.34	0.94	0.60	0.97	1.16	1.35	0.94	5.10	3.04	5.42
Perylene	2.37	3.02	1.40	1.96	2.03	3.29	3.90	2.50	3.24	2.08	2.57	2.36	1.48	2.67	1.57	3.98	4.23	3.91
Indeno(1,2,3-cd)pyrene	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.11	0.00	0.17	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.96	2.70	1.92
Benzo(g,h,i)perylene	1.07	1.89	1.53	1.85	1.04	2.06	1.40	2.30	2.17	1.96	1.46	1.29	0.97	1.86	1.41	1.85	1.43	1.28
ΣPAH	61.8	70.1	60.0	79.3	74.8	83.1	85.2	93.4	88.0	69.7	64.6	65.5	77.9	78.0	68.4	40.5	34.8	33.6

Table A.31. Summary of raw results (µg/Kg, dry wt) for triploid oysters - August 2012.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	0.26	0.53	0.52	0.84	0.58	0.67	0.56	0.72	0.75	0.44	0.44	0.57	0.32	0.44	0.45	0.85	1.26	0.88
Benzothiophene	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.16	0.00	0.16	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	0.47	0.34	0.32	0.36	0.45	0.50	0.42	0.60	0.30	0.40	0.43	0.28	0.46	0.30	0.33	0.50	0.76	0.49
Biphenyl	1.81	1.57	1.17	1.32	1.82	1.35	2.34	1.94	2.07	1.44	1.43	1.29	1.37	2.02	1.07	0.00	0.00	0.00
2-ethylnaphthalene	0.71	0.69	0.54	1.00	0.62	0.62	0.95	1.07	0.99	0.63	0.90	0.67	0.87	0.62	0.48	0.00	0.00	0.00
Acenaphthylene	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.21	0.00	0.26	0.00	0.00	0.00	0.00	0.00
Acenaphthene	0.54	0.60	0.56	0.61	0.57	0.62	0.82	0.77	0.83	0.59	0.55	0.59	0.38	0.74	0.73	0.00	0.00	0.00
Dibenzofuran	0.85	1.86	1.31	1.56	1.78	1.72	1.91	1.11	1.46	1.25	1.27	0.72	0.76	1.80	1.17	0.29	0.27	0.28
Fluorene	0.64	0.66	0.44	0.56	0.68	0.59	0.71	0.98	0.61	0.50	0.29	0.57	0.79	0.76	0.39	0.82	0.88	0.68
Dibenzothiophene	0.43	0.91	0.50	0.92	0.79	0.87	0.99	0.50	0.74	0.61	0.75	0.43	0.39	0.87	0.59	0.68	0.55	0.51
Phenanthrene	1.70	2.13	1.88	2.03	1.86	1.69	3.02	2.67	3.46	2.13	2.60	2.15	1.91	2.00	1.52	1.90	1.09	1.02
Anthracene	0.24	0.50	0.45	0.42	0.36	0.58	0.37	0.47	0.60	0.45	0.34	0.35	0.36	0.31	0.39	0.40	0.31	0.28
Carbozole	0.65	0.51	1.01	1.32	0.87	1.44	1.32	1.10	0.87	1.12	0.60	0.97	0.67	0.66	1.11	0.00	0.00	0.00
4-methyldibenzothiophene	1.16	0.89	0.65	1.86	1.58	2.31	2.02	2.44	1.62	1.68	1.00	1.25	1.89	1.11	0.85	0.00	0.00	0.00
2-methylphenanthrene	3.95	1.62	3.96	4.25	3.88	3.73	3.28	5.00	2.75	2.97	3.99	2.58	3.33	2.20	2.94	1.03	0.88	0.73
2-methylanthracene	1.58	1.27	1.77	1.67	1.75	1.85	2.40	2.38	1.83	1.81	1.23	1.50	1.78	1.79	2.14	0.00	0.00	0.00
1-methylphenanthrene	2.85	2.98	4.62	6.68	3.76	7.0	4.08	6.04	5.73	5.26	3.61	3.92	5.54	3.50	3.95	0.00	0.00	0.00
3,6-dimethylphenanthrene	2.32	3.55	2.20	5.38	4.67	5.08	5.65	3.58	5.09	3.76	3.44	3.56	3.39	5.18	3.21	1.14	0.73	0.88
Fluoranthene	1.84	1.47	1.53	1.89	1.59	2.25	2.24	2.05	2.45	1.52	1.74	1.99	1.32	1.37	1.16	1.37	1.18	1.10
Pyrene	1.56	1.87	2.31	1.88	1.84	2.18	2.58	2.51	2.61	2.16	1.45	1.59	1.44	3.27	2.32	1.31	1.07	0.84
Benzo(a)fluorene	0.99	1.04	0.82	1.61	1.89	2.04	2.40	3.46	1.18	1.27	1.16	0.94	1.44	1.14	0.89	0.00	0.00	0.00
1-methylpyrene	2.81	3.10	3.37	3.02	3.12	2.42	2.71	3.23	3.42	2.32	2.04	2.85	3.58	2.32	2.78	0.77	0.70	0.77
Benzo(a)anthracene	1.33	1.58	1.23	1.63	2.36	1.98	2.98	2.06	2.11	1.89	1.80	2.24	1.87	1.96	1.71	3.92	2.48	3.02
Chrysene	8.65	11.1	6.68	13.4	11.3	8.66	10.1	14.0	9.31	9.54	7.16	10.3	9.80	10.6	8.51	5.41	5.19	6.37
5-methylchrysene	3.79	4.87	2.73	6.49	6.94	6.13	7.45	5.00	6.64	5.55	5.47	4.51	4.64	4.95	3.37	0.00	0.00	0.00
Benzo(b)fluoranthene	1.14	2.01	1.03	1.55	1.41	2.41	1.57	1.74	1.50	1.06	0.90	1.60	1.25	1.97	1.00	1.78	1.70	1.39
Benzo(k)fluoranthene	0.58	0.44	0.72	1.30	0.73	0.83	0.74	0.81	0.62	0.88	0.57	0.53	0.70	0.45	0.49	2.48	2.14	2.00
Benzo(e)pyrene	2.58	2.05	1.93	3.38	3.03	3.52	2.76	3.89	3.83	3.01	2.47	2.66	2.62	2.62	2.35	5.21	5.23	3.67
Benzo(a)pyrene	0.89	0.83	0.92	1.02	1.21	1.34	1.12	1.20	1.33	0.88	0.50	0.61	0.98	0.86	0.93	6.93	3.16	6.30
Perylene	1.49	1.84	1.37	1.98	1.57	1.99	2.57	2.08	2.26	1.77	1.78	1.93	1.35	2.00	1.22	5.51	4.78	5.12
Indeno(1,2,3-cd)pyrene	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.12	0.00	0.12	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.72	3.91	2.33
Benzo(g,h,i)perylene	0.80	1.15	1.00	1.58	1.02	1.67	1.24	1.94	2.20	1.52	1.32	0.95	1.00	1.86	1.26	2.24	1.43	1.54
ΣPAH	49.1	54.0	47.5	71.6	64.1	68.1	71.4	76.2	69.2	58.4	51.7	54.1	56.7	59.7	49.3	48.3	39.7	40.2

Table A.32. Summary of raw results (µg/Kg, dry wt) for triploid oysters - September 2012.

	Site #1			Site #2			Site #3			Site #4			Site #5			Site #6		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Naphthalene	0.31	0.52	0.54	0.83	0.75	0.70	0.65	0.78	0.72	0.75	0.54	0.49	0.48	0.57	0.57	0.87	1.22	0.82
Benzothiophene	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.19	0.00	0.18	0.00	0.00	0.00	0.00	0.00
2-methylnaphthalene	0.47	0.30	0.40	0.64	0.58	0.62	0.53	0.77	0.42	0.51	0.53	0.38	0.61	0.50	0.62	0.44	0.76	0.52
Biphenyl	1.98	2.85	1.62	2.04	1.69	1.65	2.89	2.20	3.26	1.80	1.23	1.45	1.79	2.72	1.55	0.00	0.00	0.00
2-ethylnaphthalene	1.14	1.05	0.63	0.94	1.03	1.05	0.93	1.38	1.54	0.78	0.86	0.95	1.28	1.05	0.88	0.00	0.00	0.00
Acenaphthylene	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.21	0.00	0.38	0.00	0.00	0.00	0.00	0.00
Acenaphthene	0.61	0.82	0.63	0.99	0.87	0.86	0.89	0.74	0.89	0.74	0.66	0.66	0.49	0.91	0.96	0.00	0.00	0.00
Dibenzofuran	1.16	2.35	1.30	1.75	1.48	2.49	2.03	1.61	1.94	1.35	1.20	0.94	1.39	2.03	1.37	0.27	0.24	0.28
Fluorene	0.74	0.78	0.53	0.93	1.05	0.61	0.78	1.11	0.91	0.58	0.46	0.93	1.05	0.77	0.69	0.83	0.76	0.69
Dibenzothiophene	0.55	0.98	0.61	0.83	0.85	1.03	1.00	0.62	0.91	0.74	0.74	0.57	0.65	0.97	0.93	0.76	0.49	0.50
Phenanthrene	1.61	2.23	2.31	2.46	2.07	2.33	3.38	3.39	3.40	2.63	3.16	2.41	2.43	2.96	1.89	1.54	1.09	1.14
Anthracene	0.38	0.50	0.39	0.54	0.52	0.58	0.65	0.63	0.57	0.39	0.34	0.37	0.47	0.55	0.62	0.37	0.34	0.34
Carbozole	0.78	0.60	0.86	1.75	1.54	1.91	1.70	1.33	1.45	1.25	0.81	1.08	1.03	1.16	1.32	0.00	0.00	0.00
4-methyldibenzothiophene	1.72	1.00	0.97	1.98	1.94	2.81	2.43	3.30	1.35	1.54	1.52	1.43	2.40	1.78	1.70	0.00	0.00	0.00
2-methylphenanthrene	4.05	1.97	3.96	6.13	3.51	5.06	5.33	6.40	2.93	2.78	4.78	2.68	4.88	3.30	5.13	0.87	0.75	0.75
2-methylanthracene	2.65	1.66	2.55	2.03	2.43	1.87	3.20	2.36	3.01	2.20	1.40	1.76	2.94	2.02	2.11	0.00	0.00	0.00
1-methylphenanthrene	4.09	3.68	5.31	6.95	4.82	10.7	4.68	7.22	8.93	5.34	5.00	3.33	6.82	6.29	5.98	0.00	0.00	0.00
3,6-dimethylphenanthrene	3.19	4.54	2.99	5.47	5.01	6.21	5.63	4.21	6.03	3.62	5.31	5.42	3.39	5.77	4.61	1.12	0.76	0.75
Fluoranthene	1.88	1.54	1.84	2.04	1.89	2.47	1.95	2.31	3.32	2.53	2.58	2.03	1.76	2.49	2.00	1.24	1.11	0.98
Pyrene	1.71	1.86	2.16	2.79	2.24	2.59	2.99	3.06	2.67	2.50	2.27	2.76	2.61	3.36	2.34	1.28	1.09	0.84
Benzo(a)fluorene	1.46	1.25	1.06	2.66	2.44	3.01	2.65	3.58	1.52	1.51	1.48	1.43	1.82	1.38	1.39	0.00	0.00	0.00
1-methylpyrene	3.76	3.59	3.58	3.79	3.73	2.95	3.65	5.03	2.91	3.25	3.01	2.48	3.74	3.73	3.65	0.69	0.78	0.74
Benzo(a)anthracene	1.74	2.47	1.40	2.33	2.21	2.91	3.43	2.53	2.04	2.61	1.68	2.12	2.52	2.84	2.44	3.10	2.65	2.59
Chrysene	10.4	13.3	8.69	11.3	12.5	11.6	11.3	18.5	12.4	10.8	8.85	12.8	9.58	16.5	13.7	4.85	6.29	5.63
5-methylchrysene	4.29	5.34	3.44	8.23	8.20	9.24	8.47	7.51	6.43	6.36	5.78	4.90	5.73	7.77	4.05	0.00	0.00	0.00
Benzo(b)fluoranthene	1.69	2.25	0.85	1.85	1.76	2.84	1.60	2.21	2.09	1.26	1.08	2.00	2.32	2.57	1.38	1.86	1.83	1.36
Benzo(k)fluoranthene	0.79	0.73	1.06	1.33	0.91	1.00	0.89	0.84	0.65	0.74	0.58	0.66	1.00	0.79	0.93	2.25	2.09	1.56
Benzo(e)pyrene	3.30	2.62	1.72	4.90	3.71	3.66	3.56	4.36	4.63	3.95	2.57	4.00	3.63	2.97	2.49	4.46	4.49	3.18
Benzo(a)pyrene	1.29	0.80	0.98	1.57	1.15	1.38	1.35	1.27	1.64	0.86	0.68	0.90	1.36	1.24	1.31	6.56	3.31	4.76
Perylene	1.85	2.66	1.76	2.06	1.88	2.89	3.63	2.81	2.66	2.38	2.45	1.69	2.15	2.54	1.88	4.60	4.32	4.14
Indeno(1,2,3-cd)pyrene	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.12	0.00	0.17	0.00	0.00	0.00	0.00	0.00
Dibenz(a,h)anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.34	3.13	2.46
Benzo(g,h,i)perylene	1.13	1.42	1.29	1.97	1.18	2.27	1.62	2.07	1.94	2.27	1.17	1.67	1.39	2.66	1.55	1.81	1.60	1.59
ΣPAH	61.2	65.7	55.5	83.1	73.9	89.2	83.8	95.0	83.2	68.0	63.2	64.3	72.4	84.2	70.0	43.1	39.1	35.6

Table A.33. Summary of lipid content results (%, dry wt) for Bay Jimmy and Grand Isle sites.

Date	Ploidy	Site ID							
		#1	#2	#3	#4	#5	#6	Avg.	Std. Dev.
072811	Diploid	14.9	15.1	16.7	14.6	16.5	15.5	15.6	0.864
	Triploid	10.4	11.6	11.1	10.7	11.4	10.6	11.0	0.476
091611	Diploid	11.4	12.3	11.0	11.6	10.9	11.6	11.5	0.514
	Triploid	10.2	9.5	10.1	11.4	10.0	10.9	10.3	0.680
112111	Diploid	9.2	8.8	8.7	8.4	8.9	8.7	8.8	0.254
	Triploid	9.0	7.9	9.6	9.1	9.3	8.6	8.9	0.570
022812	Diploid	7.8	8.5	8.4	7.9	8.8	8.8	8.4	0.445
	Triploid	9.8	10.0	9.2	8.3	7.6	9.0	9.0	0.895
053012	Diploid	11.5	11.2	11.6	11.1	10.8	11.5	11.3	0.314
	Triploid	10.2	10.0	10.6	10.9	10.5	9.8	10.3	0.421
082312	Diploid	14.3	15.3	15.6	14.8	15.5	15.7	15.2	0.572
	Triploid	11.8	11.5	10.8	11.7	11.2	11.1	11.3	0.376
090712	Diploid	12.2	11.3	11.4	11.5	10.7	10.8	11.3	0.536
	Triploid	10.0	10.0	10.7	9.7	9.3	10.8	10.1	0.565

VITA

Martin Scott Miles was born in Baton Rouge, Louisiana. After finishing high school in 1983, he attended Southeastern Louisiana University in Hammond, Louisiana where he received a B.S. in Biology. After working for a few years in environmental chemistry, he attended LSU's Department of Environmental Science's graduate program where he received a Master of Science in environmental science. While working as a full-time research associate at LSU, he earned a B.S. in Environmental Engineering from LSU in 2002. He is a candidate for a Doctor of Philosophy degree in Civil and Environmental Engineering at Louisiana State University in Baton Rouge, Louisiana. For his dissertation, he worked on bioaccumulation of polycyclic aromatic hydrocarbons (PAHs) in oysters exposed to oil spills under the supervision of Dr. Ronald Malone and the help of his fellow workers at the Response and Chemical Assessment Team (RCAT) laboratory.